GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN HIGHER EDUCATION: A STUDY OF PROVISION, PEDAGOGY AND EMPLOYABILITY IN THE UNITED KINGDOM AND TURKEY

by

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ABSTRACT

Geographical Information Systems (GIS) are computer-based systems designed to store, organize, analyse and present spatial data. They can be used to help understand and answer a wide variety of problems in fields such as environmental management, resource planning and retail location and development. This thesis aims to explore the GIS education provided within university Geography departments (or units) in both the UK and Turkey. The main topics for investigation are the nature and scale of the GIS provision, the principal characteristic of the teaching, learning and assessment processes and also graduate employability – how far the courses and their students satisfied employer needs.

Although there is a substantial literature on GIS education, this thesis is different for two reasons. First, because it takes a more holistic approach to examining many aspects of GIS education within a number of case study departments. Second, because it covers two different countries, which can then be compared.

With reference to the research methods, this PhD examined ten case study departments, six from the UK and four from Turkey. The data collected were derived from a combination of student questionnaires, staff interviews, teaching observations and reading course documents. Both qualitative and quantitative were used to examine the data.

In the UK the main types of provision were found to be some 90 GIS named modules within Geography undergraduate programmes, 22 GIS Masters degrees and 7 UG GIS programmes. In Turkey, where engineering is the leading GIS discipline, there were 61 modules in undergraduate Geography, two Geography-based Masters programmes and no GIS undergraduate degrees. In the UK the great majority of GIS

provision in Geography degrees takes the form of modules which are optional, with the result that most Geographers obtain only a very limited understanding of GIS and its applications. By contrast, in Turkey, the GIS modules are typically compulsory and the subject therefore occupies a more central and prominent position in the curriculum.

In both countries, more than 70 percent of students said they were satisfied with their GIS teaching (with no statistically difference in satisfaction levels related to the gender or year of study). Although this is a positive finding, there were some weakness and disappointments. With respect to curriculum design and delivery, insufficient attention was given to use of Intended Learning Outcomes (ILOs) and in both countries students complained about too much theory and about teaching which was too heavily based on lectures and not sufficiently active and student centred (especially in Turkey). GIS staff rarely took part in teaching related CPD and GIS was little used outside the formally designated modules. GIS employer opinions were varied on the quality of graduates but common criticisms were that they lacked the business awareness and in Turkey had often poor standards of English. The links between academia and the GIS profession were patchy.

The thesis ends with over 20 recommendations, the most important of which is for Geography as a discipline to give more priority to GIS. Particularly in the UK (though less so in Turkey), many Geographers graduate with little knowledge or experience of GIS. In the age of the information economy, this is a significant missed opportunity.

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

This study was financed with the aid of a studentship from the Higher Education Council of Turkey (HECoT).

Relevant internal and external seminars and conferences were regularly attended and one presentation was made in Plymouth at the Annual Symposium of Human Geography PhD students, at which the author was awarded the prize for the best presentation. Two papers have been accepted for publication and are in press.

Publications (or presentation of other forms of creative and performing work):

- SEREMET, M. & CHALKLEY, B. 2012. Geography in Turkish Higher Education. *Planet (in press)*.
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Presentation and Conferences Attended

The author attended more than 20 Conferences and workshops. Some examples are presented below:

- Participation in a conference on **GEES Assessment for Learning** (organised by the GEES Subject Centre), 22nd June 2009, at the University of Manchester, Manchester/UK
- Participation in a workshop on **GIS in the Humanities - Spatial Literacy in Research and Teaching**, 16th December 2009, SPLINT CETL Centre, University of Leicester/UK
- Participation in a workshop on **GIS teaching: 'GIS Curriculum Provision for Spatial Planning'**, 13th January 2010, CEBE Subject Centre, University of Manchester, Manchester/UK
- Participation in a workshop on **A Celebration of Research-informed Teaching Practice within the University**, January 24th-28th 2011, Teaching and Learning Directorate, University of Plymouth
- Participation in a conference on **Human Geography PhD event**, 29th May 2012, PhD training centre of Plymouth University, Plymouth/UK

External Contacts

In addition to visiting 10 Case Study Departments, separate advisory visits were made to Birkbeck College and University College London.

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CHAPTER 1 : INTRODUCTION

1.1 Introduction: Rationale and Academic Context

During the last half century, particularly in the advanced and prosperous countries, such as the UK, there has been a transformation from an industrial society to an information society (Toffler 1990). This shift has brought a number of innovations significantly affecting almost all areas of life including, for example, employment, leisure, education, travel and the home. Through this process, there has been an explosion in the amount of knowledge and data available particularly through technological developments in the field of information and communication technologies (ICT) (Mackay et al. 2001). In the first instance, these new technologies have been used for collecting and disseminating new information and in this way for increasing economic production, efficiency and wealthy. A key aim of the advances in the technological field has been to enable companies and organizations to operate more effectively and to make more informed decisions more quickly. For individuals, advances in areas such as mobile phones and personal computers have been equally transformative. Within this development process, Geographical Information Systems (GIS) has been one of the important technological advances. As has been the case in the early development of many new technological tools (e.g. internet, intranet), GIS was initially used (among other things) for land survey and cadastral maps, not least because of its link to surveying and terrain analysis. However, today it has a wide range of spatial applications from resource planning to retail development and includes many other forms of locational analysis. GIS has therefore been associated with important advances in the storage, analysis and presentation of many form of spatial data including the Population Census.

Moreover, GIS technologies are continuing to advance rapidly, as is the range of applications. GIS has facilitated the integration of spatial information into people's daily lives. Indeed, the application of GIS technology is vital to meet with the spatial information needs of modern society and to solve a variety of real-world problems.

This rapid explosion of spatial information and ways of analysing and presenting it, demands an adequate provision of appropriately trained GIS-literate individuals who are able to use this technology for professional and commercial purposes in the GIS market. This field of employment is principally occupied by Geography graduates in the United States of America (USA) (Solem et al. 2008) and partly so in the United Kingdom (UK) (Gedye and Chalkley 2006). An important modern issue is how to train GIS-literate staff, because GIS is today a multi-billion dollar industry across the world. Within this context, University Geography departments, particularly in the USA and the UK, have taken a leading role in training people to use GIS. The GIS field has, therefore, become an important teaching subject matter in many Geography degree programmes at undergraduate and postgraduate level and also one of most important subject-related employability areas for Geography graduates. Although GIS training has generally started at Higher Education (HE) level, nowadays GIS is also becoming a little more embedded in school education most notably within Geography. On the other hand, the diffusion of GIS into other disciplines has also become more widespread, from science to social science departments particularly at HE level (Couclelis 2004, Janelle and Hespanha 2009).

Although there is no robust evidence quantifying the amount of GIS provision outside of Geography, it is certainly on a very small scale, including perhaps a small number of modules in departments such as Geology and Business Studies. The very limited scale of non-Geography based GIS provision was confirmed by the author's e-mail survey[1] amongst the UK's Subject Centres who until recently led the national promotion of HE curriculum and teaching developments in all the main subject areas. It was also confirmed by personal correspondence with Prof. David Unwin, one of the UK's leading GIS academics.

Debates about GIS education were initially focused mainly on curriculum issues, not least because it was obviously important to provide the basic content and components for GIS subjects. Most of the early studies on what to cover and prioritize in the curriculum were produced in the 1990s (Kemp and Goodchild 1992, Kemp and Goodchild 1991b, Unwin et al. 1990). After that, the focus switched more to pedagogical issues such as how to deliver effective GIS teaching within/outside the classroom (Wikle and Finchum 2003). Although these developments are important in the GIS literature, many of papers have been US-oriented (Bednarz 2004, Carlson 2007, Drennon 2005, Lloyd 2001, Wilder et al. 2003, Zerger et al. 2002). Furthermore, many of the GIS teaching studies (Berdusco 2004, Blakemore 1992, Morgan and Fleury 1992, Rhind 1987, Wikle and Finchum 2003) are becoming out-dated, not least because of changes in GIS technologies, and in lecturers', students' and employers' needs and expectations. It is particularly interesting to note that no recent papers have focussed on the scale and pattern of GIS course/module provision within UK degree-level Geography. It is therefore important to investigate the current situation of GIS education in the UK, particularly in the dominant discipline, namely Geography. For this reason, the first focus of interest in this PhD research will be on the scale and pattern of the provision of GIS education in Geography departments (or departments in which Geography is a recognized

[1] In 2009, an e-mail inquiry sent to all 24 UK Subject Centres asked whether they have any GIS activity in the disciplines with which they work. The 15 which responded all said "No", but there were 9 non-respondents.

section or unit). This discussion will not only seek to identify the extent to which Geography departments are making GIS provision, but also to determine the factors which may account for its presence/absence in different kinds of departments and institutions.

However, the provision of GIS is only the starting point for this research. The second area of focus is GIS pedagogy and the nature and quality of teaching and learning. There is a literature on instructional methods in GIS subject matters (see, for example, Carlson 2007, Raper 1991, Raper and Green 1992, Wilder et al. 2003), but these studies have typically taken a case study approach and often focused on only a single course, module or piece of software. By contrast, this new PhD research will examine GIS teaching in a number of departments and in a number of settings. The principal context is within the undergraduate Geography degree but the research will also consider examples of whole GIS degrees at undergraduate and Masters levels. Additionally, the pedagogy section of this study will set out a two-sided review, which means the lecturers' and the students' opinions will both be examined in order to critically evaluate the reasons for using particular teaching methods and what teaching methods are the most common and valuable in the delivery of GIS education.

The third and final aspect of the study is employability. Promoting employability in UK Higher Education has become one of the main agendas of Higher Education Institutions (HEIs), not least because high employability rates for graduates are increasingly considered a priority by the UK government and education policy-makers (Department for Business Innovation & Skills (BIS) 2011, Department of education and skills (DfES) 2003). Therefore, Geography departments are also taking an increased interest in student employability, although the amount of empirical evidence on geography graduates' careers remains quite limited (Brown 2004, Gedye and Chalkley 2006, Gedye et al. 2004, Owen 2001, Solem et al. 2008, Whyatt et al. 2011). Nonetheless the existing research has shown that promoting the employability of Geographers depends not only on developing their transferable skills, but is also related to their technical skills including their expertise in GIS. Therefore, it is important to know what employers might look for in relation to GIS skills (Brown 2004 and Whyatt et al. 2012). A key approach to employability is through curriculum guidance statements (specifying minimum levels of achievement): the Body of Knowledge (DiBiase et al. 2006) – discussed in chapter 3 – is one such statement for GIS. One outcome from the present study will be, by reviewing a sample of Geography and GIS courses and modules and by containing a sample of GIS companies/employers, to assess how far the courses are meeting employer needs. The employment dimension is particularly important for Geography as a discipline because GIS is widely seen as an area of the subject which offers direct vocation value (Whyatt et al. 2011).

The starting point and main focus of the thesis is on Higher Education in the UK. However, the author is from Turkey and it is a requirement of my PhD grant (see section 1.3) that on completion of my doctorate I return to Turkey to teach geography and GIS at a Turkish University. Under these circumstances, after some discussions, it was considered appropriate and useful for this study to include a chapter (chapter 9) which focuses on GIS education in Turkey, it was for me particularly interesting to conduct research in my homeland. The questions investigated and the research methods used match those adopted for the UK studies. In this way it is possible to make some potentially interesting contrasts between GIS education in Turkey and the UK and to consider how far the two countries might be able to learn from each other's experience.

It is hoped that this Turkish element will add an interesting additional dimension to the PhD research. Much of the existing literature on geographical education is focussed on countries such as the UK, the USA and Australia: for this reason the Turkish element will break new ground and add an original distinctive ingredient, while at the same time preparing the author for his return to Turkey as a GIS lecturer. To date there is very little literature or research on GIS education in Turkey (Demirci and Kocaman 2007, McAdams et al. 2009) and so this study provides an important initial 'stock-taking' exercise and an opportunity for GIS education in Turkey to be benchmarked against the UK, where GIS education has a longer and better established track record.

1.2 Thesis Aims

The discussion so far has begun to set the scene for this thesis and its research. It has introduced the idea that GIS is an important part of a much wider shift towards an 'information society' and that one of the very many specialist roles of Higher Education is to produce a supply of employable graduates with knowledge and expertise in the GIS field. Although GIS education is not the exclusive province of Geography departments in the UK (and still less in Turkey), they do provide a "natural home" for GIS teaching and in the UK are the major providers. Moreover, as an academic discipline seeking to strengthen its employability credentials, Geography needs to capitalize on GIS as an area of career opportunities for its students.

Having established the importance of this topic area, this thesis presents the first PhD undertaken in the UK to address GIS education. Its overarching aim can be summarized as follows:

to review and critically evaluate the role of Higher Education Geography in the provision of GIS education. Particular attention will be given to the GIS curriculum, the character and quality of GIS teaching and the extent to which what is taught matches the needs of GIS employers. The principal focus of the study will be on the UK but for comparative purposes a similar but rather briefer study will also be undertaken of GIS education in Turkish Geography departments. Within this overarching aim, there are four broad sets of related research questions:

- With respect to course provision, how many courses/modules are offered, at what level (s) and in what kinds of institutions?
- With respect to teaching, what are the key components in the GIS curricula, and how do these vary between courses and at different levels (e.g. undergraduate and Masters)? What are the key features which characterise GIS teaching and its quality? In terms of recruitment and student evaluations, how popular are GIS courses? And most importantly, what are the key issues and challenges as seen by lecturers and by students?
- With respect to employability, what knowledge and skills are prioritized by GIS employers and how satisfied are they with the quality of recent graduate recruits, particularly those with a Geography background?
- With respect to the principal research findings, what are the implications for policy and practice? How might GIS provision and teaching be improved? What could the UK and Turkey learn from each other’s experience?

The fact that these aims are pursued in two different countries makes this a particularly challenging academic agenda and programme of work. This challenge is made more demanding by the fact that the author initially had no familiarity with the UK HE system and that the thesis must be presented in English which is not the author's first language. However, the scale of the challenge is matched by the many opportunities it offers for the author's personal development and learning as outlined in the next section. This emphasises that the PhD programme is seen as a vehicle for advancing the author's research and professional skills: it also, places the thesis, in a personal context and sets out the key personal objectives to be achieved through the research programme.

1.3 Personal Context and Objectives

While acknowledging the primacy of the academic goals set out above, it is important to make clear that this research was also undertaken to help the author achieve a number of objectives related to his own career and to satisfy the requirements of the grant funding agency.

Prior to undertaking this PhD programme, I had been working since 2005 in Canakkale Onsekiz Mart University in Turkey, as a Research Assistant. I did my Masters study on Geographical Education at HE level and became involved in a number of international projects on Geography teaching in HE including networks such as HERODOT (the European Geography network), INLT (the International Network for Geography in Higher Education) and GEES (the UK's Subject Centre for Geography, Earth and Environmental Sciences). My Masters thesis focused on the instructional methods used for Higher Education Geography teaching in Turkish Geography departments (Seremet 2008). All of these experiences **consolidated** my interest in Geography education at University level and led me to consider studying overseas. Additionally, there are two principal reasons which encouraged me to focus my PhD particularly on GIS education. The first is the research gap in this field, as indicated in section 1.1. The second is that GIS is a field of growing importance and one which I find especially interesting.

There were also two main reasons for choosing Plymouth University. One was the presence at Plymouth of both the GEES Subject Centre, with its role of promoting and enhancing Geography education at HE level and also the Experiential Learning Centre for Excellence in Teaching and Learning (CETL). The second was that Plymouth has a large and prestigious Geography department whose undergraduate degree programme includes GIS.

In 2009 I successfully secured a grant from the Higher Education Council of Turkey (HECoT) to pursue a doctoral study in the UK. The overall aim of the HECoT scholarship programme is to encourage Turkish students to develop a wide range of academic and research skills, along with gaining knowledge and experience of academic life in a developed county's HE sector. In addition to the academic aims for my PhD outlined in the previous section, listed below are therefore the wider aims of my doctoral programme including what I planned to learn from this research process and the kinds of skills I wished to improve. Towards the end of this thesis in chapter 10, I will review how far these ambitions and also the thesis academic goals have been achieved.

In line with the HECoT's expectations, I have therefore pursued several personal and professional objectives. These can be outlined as follows:

- To develop further my qualitative and quantitative research skills.

- To improve my GIS skills so that on returning to Turkey I will be well placed to deliver GIS teaching at HE level. (A condition of my scholarship is that I work in a Turkish HEI for at least eight years.)
- To improve my academic foreign language (English) skills, both spoken and written, so that I am able to undertake a number of academic activities such as giving presentations at international conferences, conducting international projects and preparing papers for international journals.
- To develop an academic network in my research field in order to provide opportunities for future collaboration and cooperation with non-Turkish academics.
- To develop an understanding of the management, organization and academic culture of British Universities. This is also important because Turkish Higher Education has started to undertake a reconstruction process involving closer integration with the European Higher Education Area (EHEA) and the adoption and implementation of the Bologna principles. This process is expected to be completed at the end of 2012 which is the time of my PhD submission.
- To strengthen further my understanding of pedagogic trends and issues in Higher Education so that, on returning to Turkey to take on a lecturing role, I will be able to promote curriculum innovation and to discharge my teaching duties at a high standard.

Seeking to achieve these various personal and professional ambitions and to satisfy the expectations of the HECoT have been key components of my PhD experience and programme. However, it is important to emphasize that my academic PhD research and the preparation of this thesis are central to the achievement of these wider goals (the two fields of operation are closely related) and that my PhD thesis stands as an original contribution to knowledge and a significant academic achievement in its own right.

1.4 Thesis Structure

This opening chapter ends by briefly outlining the way in which the rest of the thesis is organized. Chapter 2 is designed to place the UK GIS experience in context by introducing the principal characteristics of the country's HE system as a whole and recent developments in the teaching of Geography. This provides a platform for a discussion in chapter 3 of the evolution of Geography-based GIS education, particularly in the UK. The information in this chapter is again based mainly on the existing published literature.

Having by this stage outlined the thesis aims and reviewed the relevant literature, chapter 4 moves forward to a discussion of the research methods and the data sources needed to enable the achievement of the research aims. This includes an account of the main data collection methods adopted in the case study departments such as the staff interviews, the student questionnaires, the employer surveys and the web-based information which helped particularly to identify GIS courses and modules. The research methods used were very similar in both the UK and Turkey and so the methods chapter provides a context for both the UK and the Turkish findings.

The next four chapters (5-8) set out the results from the UK investigations and deal in turn with the patterns of GIS education provision in Geography; lecturer perspectives on pedagogical matters; student perspectives and opinions and then in chapter 8 the issue of employability, where information is provided both from academic staff and students and also from a selection of relevant employers.

In chapter 9 the focus of the research turns to the Turkish experience. A brief introduction is provided to the Turkish HE system and to Geography's position within it and this is then followed by the Turkish survey results on GIS provision, staff and student perspectives and employability. This deliberately mirrors the way in which the UK findings are presented but in the interests of brevity the discussion is less detailed. The chapter closes by highlighting some of the main points of similarity and contrast between the UK and Turkish findings.

Chapter 10 closes the thesis with a summary of the overall key findings from which are then derived a number of recommendations for policy and practice in the field of GIS education, including ways in which Turkey and the UK might learn from each others' experience. After some brief suggestions for future research, the thesis ends with some reflections on how far the research has achieved both its academic aims and the author's own personal and professional objectives.

CHAPTER 2 : UK HIGHER EDUCATION (UK HE) AND THE PLACE OF GEOGRAPHY

2.1 Introduction

The role of this chapter is firstly to outline the evolution and the changing scale, nature and purpose of UK Higher Education (HE) and in particular to highlight recent developments in curriculum and pedagogy, including the increased emphasis on graduate employability. This account of UK HE is obviously far from comprehensive but it does set the scene for the second main theme in this chapter which is the development of Geography in UK HE and how teaching and learning in the discipline have been affected by wider trends and issues across HE as a whole. By providing this introductory review of HE and Geography, the chapter aims to outline the context within which Geography-based GIS teaching takes place. In addition therefore to providing an important background for the later discussion of GIS education (chapter 3), the reading undertaken for this chapter has helped the author achieve one of his own personal/professional objectives, namely to obtain a better understanding of UK HE and of recent developments in UK Geography teaching. The author is also mindful of the fact that this thesis is likely to be of interest to a non-UK audience (particularly Turkish academics) and so it is important to provide at the start some basic information about UK HE and UK Geography which will assist overseas readers.

2.2 The Changing Scale and Purpose of UK Higher Education (HE)

Although the first Universities in what is now the UK were Oxford (c.1109) and Cambridge (c.1298) (Becher 1987), almost all of today's UK Higher Education Institutions (HEIs) are of much more recent origin. For example, following the industrial revolution, several of the UK's principal industrial cities established Universities in the nineteenth or early twentieth centuries, examples being Birmingham, Manchester, Leeds and Liverpool (Holmes 2001). Many of these HEIs are often referred to as 'Civic' or 'Red-brick' Universities. From the 1950s onwards, a major increase occurred in the number of Universities because successive governments wanted to increase student participation rates. For example, seven new Universities were launched in the 1950s (Rich 2001) and more followed in the 1960s and 1970s after the publication of the Robbins report (1963) which highlighted the importance of increased graduate numbers to meet the growing needs of the national economy. Later, a particularly important change came in 1992 when Polytechnics (principally focussed on vocational education) were awarded University status.

Students numbers have grown dramatically from some 400,000 in the early 1960s to 2.4 million by 2009 (Higher Education Statistics Agency (HESA) 2009), with a parallel growth in the HE participation rate from 6% to approaching 45%. These figures illustrate the transformation from an 'elite' to a 'mass' HE system. By 2009 the UK's HE sector included 165 HEIs with 115 carrying full University title, though it is important to recognize that about half of the undergraduates and a third of the post-graduates are registered as 'part-time', which no doubt reflects the financial benefits of students 'earning while learning' (Galindo-Rueda et al. 2004).

In addition to these major changes in the scale of HE provision, there have been related changes in its role and purpose. Even since the Robbins Report (1963) there has been an increasing emphasis on the importance of HE meeting the skills needs of employers and more recently on enabling British businesses to remain competitive in the face of globalisation and increased international competition. The Dearing Report (National Committee of Inquiry into Higher Education (NCIHE) 1997) in particular emphasised the need for a highly-skilled graduate workforce to meet the requirements of a learning society, and one based increasingly on the processing, use and analysis of information.

Although there has been a long-running debate about the level of priority to be given by HEIs to employability[2] as against social goals (such as students' personal development), there can be no doubt that meeting the needs of the economy (Harvey 2000) has substantially increased in importance. This is in part because several employer surveys conducted by organisations (Conferedation of British Industry (CBI) 2003, The Guardian: Jobs and work 2006) and by individuals (Branine 2008, Green 1990, Robins and Gowar 2003) showed that employers were not satisfied with the quality of graduates emerging from the UK's HEIs in terms of their readiness for the world of work and their transferable skills (for example, communication, team-working, numeracy, and giving presentations). In this climate it is not surprising that UK Geography departments have (as discussed later in section 2.4) been reviewing their curricula and their teaching with a view to giving increased priority to graduate employability. In this regard it is important to emphasise for the purposes of this thesis that GIS is potentially an important vocational asset for Geography and its students.

The increased commitment to meeting the needs of the economy has certainly affected all UK HEIs; however those in the 'Russell Group' in particular, such as Bristol and Durham, have continued also to celebrate and prioritize their research expertise and also their commitment to research-led teaching in which teaching is

[2] The most commonly accepted definition of Employability is "a set of achievements, skills and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, and which benefits themselves, the workforce, the community and the economy" (Yorke 2004, p.410).

designed to ensure that students' learning is enriched by the staff's research. Although this particular philosophy is most commonly associated with the older Universities, many of the former Polytechnics have also been increasing their research commitments. There is, however, a long-standing debate as to whether taking part in research actually does improve the quality of staff's teaching or whether research diverts staff's attention away from the pursuit of high quality teaching (Gibbs 1995, Lindsay et al. 2002, Gibbs 1999, Hattie and Marsh 1996). One interesting recent piece of evidence on this debate is that more than a third of the 24 Russell Group HEIs are in the bottom 40 of the 125 institutions rated by their students for the quality of teaching in the 2012 National Student Survey (Lightfoot 2012).

In the UK each HEI's level of research achievement is measured every few years in a national review exercise which has at various times been known as the Research Assessment Exercise (RAE) and the Research Excellence Framework (REF[3]). This mechanism is then used as a basis for allocating substantial amounts of research funding. Although, there is no equivalent formula for financially rewarding teaching excellence, there has nonetheless been a greater emphasis on the issue of teaching quality over the last twenty years or so. One of the most important reasons has been that governments want to ensure that their growing investment in HE is being well spent. Additionally, since students are now paying fees, they are increasingly demanding value for money and high quality courses. Another factor is that employers, who are one of the main stakeholders in HE, expect HEIs to produce a well-skilled workforce (Ashwin 2006). Two of the best indicators of the priority given

[3] The RAE, which is now known as the REF, is an exercise undertaken on a regular basis (typically every five or six years) which enables the HE funding council to determine the future amount of research grant for particular disciplines/areas of research in every HEI. The reader wanting to know more about how this exercise works can consult the following web address: www.ref.ac.uk for detailed information.

to teaching quality are the emphasis it has received in government reports and policies (Department for Education and Skills (DES) 1991, Department of Education and Skills (DfES) 2003) and the number of governmental initiatives to promote high quality teaching, many of which have been led by or overseen by the Higher Education Academy (HEA)[4] whose mission has been to “provide the student in UK HE with the highest quality learning experience in the world” (HEA 2010). Examples include the National Teaching Fellowship (NTF) scheme, Centres for Excellence in Teaching and Learning (CETLs) and Subject Centres. The NTF scheme rewards teachers of outstanding quality by providing a money prize (currently £10.000) which is to be used for their further professional development. In addition, the 74 CETLs each brought in up to £4 million of extra funding to develop further and disseminate an approach to teaching in which the particular host University excelled. One of the 74 CETLs, based principally at Leicester University, was devoted to developing and disseminating best practice in Spatial Literacy and GIS education (see section 3.5) and is therefore of particular relevance for this thesis.

The 24 Subject Centres, each based in an appropriate HEI and typically funded by about £0.5 million per year, had the task nationally of encouraging and disseminating best practice in teaching the discipline(s) for which they were responsible. Plymouth hosted the HEA Subject Centre for Geography, Earth and Environmental Sciences (GEES), which among many other things, provided a small number of workshops on teaching and learning in GIS.

Unfortunately, although the HEA continues to operate, as a result of funding cuts the CETL programme was not continued beyond its initial five-year period and came to an end in 2010. Funding for Subject Centres has also been terminated, although the

[4]Please see the HEA web-site for further information (http://www.heacademy.ac.uk)

HEA continues to have an interest in discipline-based approaches to raising the quality of teaching and encouraging innovation (Chalkley and Kneale 2011). Although the current economic climate of austerity and public-sector budget cuts is certainly limiting the financial support for innovation and quality enhancement at the national level, most HEIs continue to have their own education development units whose staff encourage new teaching initiatives and provide training courses for incoming academic staff with less than three years teaching experience. And at the national level, despite the HEA's more limited resources, the Quality Assurance Agency (QAA) continues its role of every few years inspecting the quality of teaching in all the HEIs.

In addition to their principal work in teaching and research, Universities are also increasingly expected to provide activities such as business advice, consultancy, training courses on entrepreneurship and 'spin off' research into commercial products and services. This is often referred to as the 'third arm' mission (Jones et al. 2005, Shattock 2008) which can include, for example, working with local authorities and the voluntary sector as well as commercial organisations.

In summary, therefore, although the main roles of UK Universities continue to be teaching, research and third-arm activities, there are a number of important changes and challenges facing British HEIs. With respect to teaching, these include maintaining teaching quality in a period of financial constraints, and widening participation to more students from poor backgrounds at a time when tuition fees have risen substantially. Internationalisation is another key agenda (Haigh 2002), not least because recruiting overseas students (especially at Masters and PhD level) has become an important source of funding (de Vita and Case 2003), with non-UK students now accounting for some 15 percent of the total student population. With respect to the curriculum perhaps the main development is the increasing emphasis on employability which will no doubt intensify further as students will expect their degrees to result in well-paid jobs which will enable them to pay off the debts and loans built up partly because of the much higher tuition fees.

Having now provided a brief general introduction to UK HE, the next section addresses trends and issues in HE pedagogy. The teaching of Geography and GIS does not take place in a vacuum and is inevitably influenced by the wider patterns and challenges facing HE teaching as a whole. It is helpful therefore for the reader to understand this context, although the account given below focuses only on some of the key developments and can obviously not be comprehensive.

2.3 Trends and Issues in HE Pedagogy and the Related Literature

Since the early 1990s, improving the quality of teaching has been one of the main concerns in UK HEIs. Green (1994) asserted that making changes in teaching and learning can greatly enhance the quality of education provided (cited in Bennett et al. 2000). Increasingly, student-oriented approaches have moved into the foreground in HE pedagogy and pedagogic research (Boud 2007). Therefore, students' learning experience and the environment in which teaching and learning take place have become a more important concern. In the last two decades, this issue of how students learn was addressed by a number of researchers including Biggs and Tang (1999, 2009), Prosser and Trigwell (1999), and Ramsden (1992). A main focus in Ramsden's 1992 book ('*Learning to teach in HE*') was on variations in the way students go about learning, based on the 'surface and deep approaches' derived from the work of (Marton and Saljo 1976). Biggs and Tang (2011) asserted that the motivation levels of students also cause significant variations in the way students approach learning and that student-centred learning activities (e.g. problem-based learning and project-based learning) tend to enhance student engagement. Taken together, these kinds of studies illustrate that the focus of pedagogic research and development has shifted from the staff's delivery methods to the students' learning experiences.

The growing interest in researching teaching and learning at HE level has led to a major upsurge in the amount of published material, particularly peer-reviewed papers. Several highly-rated academic journals in educational sciences are now publishing papers covering a wide variety of issues in Higher Education ranging from teaching and learning to educational management (*e.g. Higher Education Quarterly, Assessment in Higher Education*). It is important to note that one of these journals deals with geographical education at HE level (Journal of Geography in Higher Education-JGHE, see Jenkins 1997). According to Beard (1968), there were 144 HE studies dealing with teaching methods published in the period between 1960 and 1968 (cited in Ashwin 2006, p.11). At present, a search in *Google Scholar* using the keywords 'teaching and learning in Higher Education' returns more than 1.5 million results (*the date of search: 01.10.2010*). So, it is abundantly clear that there is now a vast array of literature on the topic of teaching and learning in HE.

This literature covers a wide range of teaching, learning and assessment themes, but among the most prominent are theories related to experiential and active learning. Kolb (1984) summarised his experiential learning theory as follows: '*Learning is the process whereby knowledge is created through the transformation of experience'* (p.38). Experiential learning theory was built on the basis of ideas from Dewey, Lewel and Piaget (Kolb 1984). Kolb's thinking rested on two main principles: i) facilitating learning for individuals can be achieved through encouraging them to reflect on their experiences; ii) each individual has his/her own strengths and weaknesses, meaning that each person has a different learning style and approach to learning (Kolb 2000). According to these basic principles, he identified a learning cycle that moves from concrete experience through reflection and conceptualisation to experimentation (Figure 2.1). This process not only identifies the formal learning process based on education, but also covers individuals' learning processes throughout their life. One of the most important implications of this learning theory is that the lecturers should adopt a wide range of teaching methods which are appropriate to their module ILOs and to the variety of students' learning styles. In UK HE, Geography is one of the disciplines which uses Kolb's experiential learning very frequently as a theoretical basis and rationale especially for fieldwork (Haigh 2012, Healey and Jenkins 2000). One of the CETLs based at Plymouth University was focused on experiential learning (http://www2.plymouth.ac.uk/science/elcetl/about.html).

Figure has been removed due to Copyright restrictions.

Figure 2.1: Kolb's Experiential Learning Cycle and Embedded Learning Styles
(adopted from Healey et al. 2005, p.32)

A concrete experience (CE) process (Figure 2.1) could be achieved by leading students into a position where they encounter examples of real GIS projects and their applications or case studies containing real examples (e.g. visiting a planning office of the City Council to see a basic GIS operation). This process could be especially helpful for those learning with a "Diverging" style (Figure 2.1) who prefer to watch rather than act. In order to conceptualise objects and processes observed, students should also be involved in theory classes to promote subsequent conceptualisation and the formulation of ideas and hypotheses. This would be especially suitable for "Assimilating" students who learn best through observation, abstract conceptualisation and formal lectures and reading.

If this stage is followed by practical sessions, then students would have an opportunity to practise the things they theorized in their cognitive process (Gibbs

1998). This process would be more efficient if they could be provided with problem-solving practicals, which bridge conceptualisation and experimentation. Students who excel in the stage of “Convergence” are good at evaluation, plans and ideas, selecting from alternatives and solving problems (Healey and Jenkins 2000). The last stage of the experiential learning cycle focuses on Active Experimentation (AE) involving the actual implementation of plans. Here “Accommodator” students will learn best as they particularly enjoy strongly practical and experimental approaches. This stage has also been described as a “transforming stage” where students can transfer the knowledge and skills gained into the arenas of policy and practice (Healey and Jenkins 2000).

Healey and Jenkins (2000), both Geographers, have built on Kolb’s learning cycle by providing a similar model (see Figure 2.2) which expresses the four phases in Kolb’s cycle in terms of most appropriate teaching and learning activities. For example, they suggest that increasing awareness of experience is best achieved by activities such as log books and listening exercises. By contrast, in the final stage of full experience, the focus is on action, on plans, on designing experiments and on research.

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Figure 2.2: Practical methods to implement the experiential learning cycle
(adopted from Healey and Jenkins 2000, p.36)

Although Kolb's theory has attracted a lot attention, when looked at critically it has both positive and negative features. On the positive side, it recognises that learning can take places in many arenas outside the academic setting of classrooms and lecture theatres. It also points us towards the importance of the deep or lasting learning which accompanies direct observation, participation and experience (McCarthy and McCarthy 2006). Kolb has in addition encouraged a more conscious awareness of the value of seeing learning as a multi-stage process and recognizing that individual students learn differently, with some learning more than others from the same educational activity (Healey et al. 2005).

On the negative side, it must be acknowledged that while highly plausible, Kolb's theory does not rest on a substantial body of empirical evidence. This matters because in the modern era, Higher Education approaches to teaching and learning are expected to be "evidence-based". In particular, there are doubts as to whether it is possible to obtain reliable evidence which would categorize students as exhibiting or belonging to particular "learning styles", or what the implications would be even if students could be classified in this way. Student cohorts are inevitably mixed thereby making the design of teaching activities complicated because no single strategy can satisfy every learner (Healey et al. 2005). Moreover, perhaps staff should not even try to appeal to particular learning styles because there could be a case for challenging students by confronting them with types of activity and modes of learning which they find difficult and not closely aligned with their own established cognitive structures (Healey and Jenkins 2000). Moreover, it is also possible to argue that experiential learning, if taken too far, could be seen as a treat to serious scholarship in that a reliance on personal experience is no substitute for students engaging with the literature and acquiring knowledge through the traditional approach of "reading for a degree".

So Kolb's theory raises many questions and can certainly be contested. Perhaps its main impact and legacy is the promotion of more active and engaged forms of learning. The concept of active learning "rests on the basic assumptions that learning is by nature an active endeavour" (Meyers and Jones 1993, p.11) and that learning by doing is especially effective because it allows students to go beyond mere memorization and to achieve more deeply grounded and lasting learning (Kirschner et al. 2006, Mayer 2002), particularly through approaches such as problem-based learning, project-based learning and enquiry-based learning. It is measure of the interest in Active Learning that one of the CETLs (based at the University of Gloucestershire) was focused on this theme (http://resources.glos.ac.uk/ceal/index.cfm).

Overall, there seems to have been something of a transition from lecture-centred strategies to active learning approaches at HE level. Meanwhile, the student dimension in the teaching and learning process has become embedded in projects, investigations and student research rather than the traditional learning from lectures. One of the drivers behind this shift is developments in pedagogic theory from behaviourism to constructivism (Boud 2007). Boud (2007) summarizes this as a more away from the delivery of subjects to the construction of knowledge.

A recent report published by Ramsden (2008), in liaison with the HEA, suggested three main areas should be focused on by HE practitioners and pedagogic researchers: i) curriculum development ii) assessment iii) enhancing the quality of teaching and learning. Given the importance of those three areas, an outline discussion of each one is provided below. This will help the reader to place the thesis findings on GIS teaching within a wider context.

2.3.1 Curriculum development

Barnett (1992) asserted that the focus in the design of subject curricula now gives less emphasis to subject-specific aims and more priority to general aims relating, for example, to themes such as employability and citizenship. While still teaching ‘about’ the subjects, increasingly the approach is to teach ‘through’ subjects in order to achieve broader goals. Bennett et al. (2000) argue that the curriculum has become more ‘vocationally-oriented’ (p.3). They also emphasised that inter- and multi-disciplinary programmes have become more common in HE provision, as HEIs have increasingly recognized the importance of breadth as well as depth (Although inter- and multi-disciplinary teaching does pose both practical and intellectual challenges). The fact that these days the curriculum is normally divided into standard sized modules/units can make it easier for students to study outside their main discipline, for example, perhaps aligning an Archaeology student to take a Geography module in GIS.

In order to inform discussions about curriculum and instructional design, Biggs (1996) advocated an approach, entitled constructive alignment, which is about how to design module components on the basis of constructivism, the origins of this approach lying in a study by Cohen (1987). Land (2004) has also implied that the constructive alignment approach is at the heart of modern curriculum design and development. According to the alignment approach, all of the main programme and module components should be consistent with each other (Figure 2.3). Within a module, for example, there should be alignment between all three of the main components, namely: the Intended Learning Outcomes (ILOs), the Teaching and Learning Activities (TLAs) and the Assessment Tasks (ATs).

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Figure 2.3: Aligning Intended Learning Outcomes with teaching and assessment tasks

(adopted from Biggs and Tang 2009, p.59)

The ILOs should set out the knowledge and skills the students should be able to demonstrate on successful completion of a module or programme. Concerning the issue of how to set ILOs, there are two prevailing approaches. One is the SOLO taxonomy which was developed by Biggs and Collis (1982) and the other is Bloom's Taxonomy (1956) which was initially developed by Bloom and later revised by Anderson and Krathwohl (2001). Both approaches have suggested a number of verbs to be used when the ILOs are being designed (see Table 2.1 and 2.2), these being structured according to the level of thinking and understanding expected. Bloom's taxonomy identified three different domains which are constructed on the basis of the different areas of abilities (cognitive, affective, psycho-motor domain). By contrast, Biggs's SOLO taxonomy was merely built on the cognitive domain, though it too has a hierarchical structure, with the level of thinking varying from what are termed 'Pre-and Uni-Structured' levels through to 'Extended Abstract'. In both models, there is an expectation that higher-order levels will be associated with deeper learning.

Table 2.1: Biggs's SOLO taxonomy
(adopted from O'Neill and Murphy 2010, p.3)

Table has been removed due to Copyright restrictions.

Table 2.2: Revised version of Bloom's Taxonomy
(adopted from O'Neil and Murphy 2010, p.2)

Table has been removed due to Copyright restrictions.

Teaching and learning activities (TLAs) are another important part of instructional design, because they are key means through which the ILOs can be achieved. For example, if a lecturer expects students to achieve and demonstrate high-order thinking, such as analyzing, evaluating and creating, they should select an activity that gives students considerable autonomy to design and manage their own learning process rather than adopting a passive role: under these circumstances Biggs and Tangs (2009) therefore advocate more use of problem-based and project-based approaches.

2.3.2 Assessment

Another key aspect of module design is the Assessment Tasks (ATs). The constructive alignment approach (Biggs 1996, Biggs and Tang 2009) advocates that each item in the ILOs list needs to be addressed by ATs, so that the ATs are congruent with ILOs, (although each task might address more than a single ILO). This approach makes clear to students what they need to achieve and the general basis on which their performance will be assessed. In addition, the students' overall assessment results make clear to the lecturer how far the module or programme is succeeding in meeting its goals. However, although in theory, this model of close links between ILOs, teaching and assessment, has much to commend it, as we shall see later in chapter 7, the PhD findings suggest that in the GIS modules studied, practice does not always match the model.

Although overall, changing approaches to HE teaching and learning have inevitably prompted a rethinking also of approaches to assessment. The volume of changes and research in the assessment field was initially limited in comparison to teaching and learning (Boud and Falchikov 2007). The reason is that assessment was traditionally treated as a separate area (Dochy et al. 2007) or simply as an event to be completed at the end of the module or programme. However, this idea has become out of date today and the emphasis has shifted from assessment for its own sake towards assessment for enhancing student learning (Brown et al. 1997). Boud and Falchikov (2006) asserted that to receive an award and also to encourage improved achievement are now two key aims of HE assessment. The shift in emphasis towards using assessment as a process through which students obtain feedback to enhance their learning provides the context within which a number of particular trends have been taking place in assessment methods such as those listed below in Figure 2.4.

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Figure 2.4: Trends in assessment

(adopted from Brown et al. 1997; p.13)

Two main approaches to assessment are identified in the literature, namely summative and formative (Table 2.3). Summative assessment represents the grading aim and allows lecturers to generate marks for the evaluation of achievements and for the award of qualifications.

By contrast, the focus of formative assessment is on feedback to students and on how the quality of student learning can be improved. In formative assessment the mark does not count towards the award or certificate: the focus is on helping students to learn and to develop their knowledge and skills. Although there is an increasing support for using formative assessment, some research (Boud and Falchikov 2007, QAA 2003) reported that the majority of lecturers are still relying on summative assessment methods, perhaps partly to reduce marking workloads.

Table 2.3: The aims of formative and summative assessment (adopted from Light et al. 2009, p.204)

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In addition, there is a growing interest in student-centred approaches to assessment particularly in order to respond to active learning ideas in the teaching process. Therefore, such assessment approaches as 'peer-assessment' (e.g. Falchikov and Goldfinch 2000) and 'self- assessment' (e.g. Boud 1995) have been gaining ground. The employability agenda has also led to a growing interest in the assessment of transferable skills, such as public-speaking and problem-solving. The trend towards placements and work-based learning has led to greater use of vivas, professional logs and reflective writing which seem in these circumstances more relevant than the traditional unseen written examination, which can also be less appropriate in subjects such as GIS which have a strong practical dimension.

Whatever the form of assessment selected, it must also meet the key requirements of being both valid and reliable. Validity refers to being relevant to the aims and learning outcomes for the programme or module. Reliability refers to the accuracy of the marks/grades awarded. The assessment method must therefore be appropriate and the scores must be trustworthy. In addition the whole process must obviously be practicable and affordable in terms of time, resources and the demand it places on staff and students.

2.3.3 Enhancing teaching quality

In setting the scene for this thesis, one final aspect of HE practice which requires discussion is how HE protects and improves quality. Although space obviously makes impossible a complete discussion of teaching quality, it is important for the thesis readers to have at least a basic appreciation of what constitutes ‘good’ teaching and of the kinds of measures which are taken by UK Universities to assure and improve the quality of their courses, including those in Geography.

Although it must be admitted that the definition of ‘good’ teaching is problematic and that there are no universally agreed criteria, from a review of the literature (including, for example, Chalkley et al. 2000, Chickering and Gamson 1987, Romer 1995), it is clear that good teaching generally has most or all of the following characteristics: clear aims and Intended Learning Outcomes, approaches which motivate and interest students, clear structure and organization, an appropriate level of difficulty for the students, good support in terms of learning resources and technologies, the achievement of deep rather than superficial learning and links to appropriate methods of formative and summative assessment.

Most of the positive features listed above are not controversial and are fairly traditional. It might therefore be appropriate to add two further features which reflect today’s educational priorities. One would be to teach not only knowledge but also transferrable skills (often linked to employability). The second is that good teaching encourages active learning so that the student is not simply passive but is actively engaged in the learning and discovery process.

The main measures typically taken in UK HE to ensure that courses and teaching meet these standards and improve the quality of provision and student learning are listed below. Once again, although this list is not comprehensive, it will help the reader (particularly if not familiar with UK HE) to make sense of the detailed research findings on GIS teaching, learning and assessment discussed later in the thesis.

Some of the most important quality measures are the following:

- HEIs have procedures to approve (validate) new programmes and periodically to review the quality of existing ones.
- For each programme one or more external examiners are appointed who check that the student assessment procedures and level of achievement are appropriate.
- For each programme and its modules, there is documentation setting out key features, such as aims, Intended Learning Outcomes, the curriculum content, and the teaching, learning and assessment methods.
- A programme committee, comprising both staff and student representatives, is charged with responsibility for the course's successful delivery.
- Though a system of peer observations, staff's teaching is observed and appropriate feedback provided.
- All newly appointed teaching staff with less than three years experience are generally required to take and pass a course on teaching and learning in HE. This course is often provided by the University's Education Development unit which also runs a programme of workshops and other events designed to encourage innovation, provide advice and improve practice.
- Students have an opportunity to provide feedback on each module and on their programme as a whole. Departments are then latter expected to inform students about actions taken in response to their feedback.

- Towards the end of their course, all students are encouraged to complete the National Student Survey (NSS) - first introduced in 2005 - which has included questions on teaching, assessment and feedback, academic support, organisation and management, learning resources and personal development. The findings for each course are published, so enabling prospective students to learn whether the current students are satisfied.
- Every five years the Quality Assurance Agency (QAA) sends an expert team to each University to check on its internal quality procedures and to ensure that teaching standards are appropriate. The QAA have also provided a series of discipline-based Benchmark Statements which outline the expected characteristics of undergraduate courses in all the main HE disciplines, including Geography.
- The Higher Education Academy (HEA) provides advice to HEIs, to subject communities and to individuals on issues such as curriculum innovation and the enhancement of teaching, learning and assessment. It does this through activities such as conferences, workshops and publications.

2.4 Development of Geography Departments and Teaching in UK Higher Education

Having provided a broad but brief introduction to British HE and recent developments in teaching, learning and assessment, the discussion now focuses down on the discipline of Geography. This section begins with some basic information on the historical evolution of Geography at HE level and then considers some of the principal hallmark features of Geography teaching, placing the discipline with the context of some of the wider HE trends discussed earlier.

The discipline of Geography has a long history in the UK (Johnston 2003, Livingstone 2003). As a teaching subject, Geography can be traced back to the 1700s and the first full HE department was established in the early 1900s. The main stimulus for this achievement was the work of the Royal Geographical Society (RGS) and the Geographical Association (GA) (Johnston 2003, Sidaway and Johnston 2007). Initially, the principal reason behind the establishment of HE Geography departments was the training of prospective geography school teachers. Although the first courses featuring Geography emerged in Oxford and Cambridge Universities, the first programme offering a full honours degree in the subject was established at Liverpool University in 1907. This was followed by other Redbrick universities such as the Universities of Manchester and Birmingham. Departments became well-established in many civic universities in the 1920s. However, it was not until the 1950s that Geography became available in the majority of UK universities (Sidaway and Johnston 2007). By the late 1970s some 26 University geography departments had been established (Kirk 1978) and in 1992 a further 43 were added to the list following the abolition of the binary divide between old-universities and polytechnics (RGS-IBG 2000 cited in Johnston 2003). More recently, however, Gardner and Lambert (2006) reported that the number of Geography departments in the period between 1996 and 2005 decreased from 90 to 78 and as Universities have increasingly sought economies of scale, Geography has increasingly found itself positioned within larger, multi-disciplinary departments, alongside cognate subjects such as geology and environmental sciences (Croot and Chalkley 1999, Trend 2009). For instance, at Plymouth University, the School of Geography has been combined with Earth and Environmental Science subjects and the title of the department was changed in 2009 from the School of Geography to the School of Geography, Earth and Environmental Sciences (SoGEES).

In the 1960s and subsequent decades, the previously discussed expansion of UK HE as a whole also led to major increases in the numbers of Geography students, which grew from 826 in 1962 to nearly 20,000 by the 1990s. Although the Geography student population reached a peak level in the early 2000s with nearly 35,000 students, the total number of recruits in Geography programmes had apparently fallen to 27,000 in 2009. However, changes in Geography's student numbers (see Figure 2.5) need to be treated with some caution, because of complexities and changes in the way in which HESA categorizes the data. In relation to the total number of HE students, Geography made up 1.11 percent of the total HE student population in 2009. So, whereas Geography occupies quite a prominent position in secondary education at GCSE and 'A' level, by contrast, partly because of the very much wider range of courses on offer at degree level, within the HE sector its role is statistically much smaller. With respect to the changes in Geography's student: staff ratio, Jenkins and Smith (1993) reported that this ratio on average increased from 12/1 in 1986 to 17/1 in 1991. More recently, the Guardian's 2011 University Guide showed that this ratio decreased to 15/1. However, the figure varies substantially among universities from 6.9 to 30.1. According to UCAS records, currently 69 Higher Education institutions with University status offer Geography and Geography-related first degree programmes (e.g. Physical Geography or Human Geography).

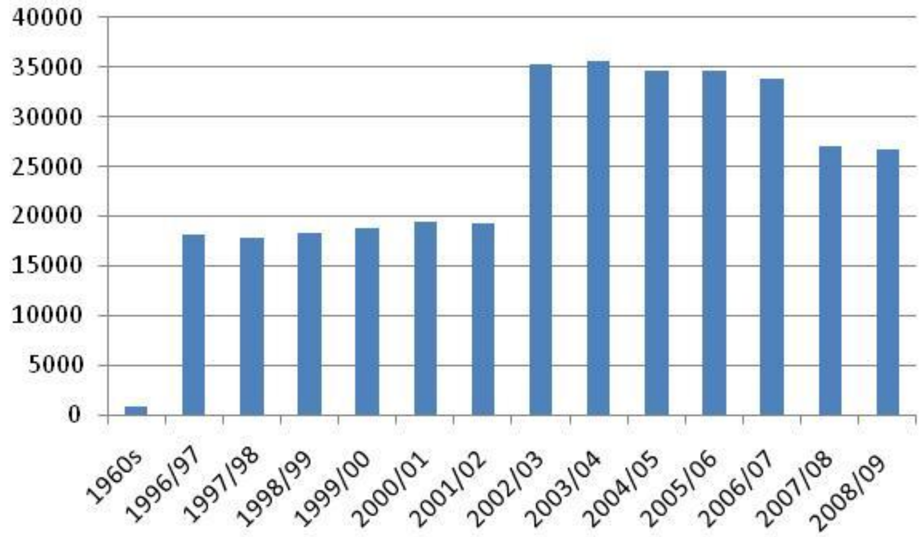


Figure 2.5: The number of total Geography students (UG+PG) in UK Geography departments

(Source: HESA 2009)

In terms of pedagogic research and publications, it is important to note that Geography was one of the first disciplines of have its own teaching and learning HE journal. The Journal of Geography in Higher Education (JGHE) was established in 1977 and has gone on to become the leading national and international journal in this field (Haigh 2012). The journal has been an important stimulus for the development of innovation and the discussion of good practice, as has Planet, the journal produced by the GEES Subject Centre. Additionally, an RGS-IBG research group entitled Higher Education was created in 1979 (Parker 1980) and continues to operate. In the 1990s, under a Department of Education and Employability (DfEE) initiative, the Geography Discipline Network (GDN) was established to spread best practice, based in the University of Gloucestershire; this was followed in 2000 by the Geography, Earth and Environmental Sciences (GEES) Subject Centre based at Plymouth University. Later there were CETLs such as the Spatial Literacy CETL (SPLINT) at the University of Leicester, the CETL on Experiential Learning in the

Environmental and Natural Sciences at Plymouth University and the Active Learning CETL at Gloucestershire University. Additionally, a European Union Thematic Network Project for Geography in Higher Education, entitled HERODOT and based at Liverpool Hope University, was undertaken for eight years (2002-2010) in order to strengthen the teaching of Geography at HE level across Europe. All these initiatives (and others) created a supportive climate for promoting the teaching and learning of geography in UK HE[5]. However, more recently funding cuts in UK HE have resulted in the closure of almost all the Subject Centres (SCs), including GEES (Chalkley and Kneale 2011) and in addition HERODOT and the CETLs have also been terminated. Geography, like other disciplines, obviously derived benefit from the variety of teaching and learning initiatives funded in the first decade of the new century and will now have to come to terms with a climate of austerity and reduced funding for educational innovation and development.

Across the past twenty years or so Geography has earned a reputation for being amongst the UK’s best taught HE disciplines. During the 1990s the national Teaching Quality Assessment (TQA) exercise involved a comprehensive review of the teaching standards in all HE disciplines and their departments (Chalkley 1994). The national overview report for Geography (HEFCE 1995) was especially positive, highlighting for example, the discipline’s commitment to curriculum innovation, to good staff-student relations and to high quality pastoral support. More recently, this generally positive review has been confirmed by the results of the National Student Survey (NSS) where in response to the key question about overall satisfaction levels, Geography has constantly achieved scores well above the HE average (White 2010). Although,

[5] Please visit the following web sites for detailed information about these initiatives: www.gees.ac.uk, www.herodot.net, www2.glos.ac.uk/gdn/, www.splint-cetl.ac.uk , www2.plymouth.ac.uk/science/elcetl/about.html

as with many other subjects, the particular scores for assessment and feedback have been rather disappointing (as highlighted by Chalkley et al. 2008), more recently the results show considerable improvement and that even in these potentially problematic areas, Geography is performing above the average (White 2010). The precise interpretation of NSS data is admittedly made difficult by complications surrounding the Joint Academic Coding of Subjects (the JACS codes) and by the inclusion of other subjects in predominately Geography's groups (Jones 2010), but nonetheless the main message is clear, namely that nationally well over 95% of Geography students are satisfied with the quality of their courses (Readers interested in more details on the most recent – NSS results for Geography are invited to consult part of the HEA website – http://www.heacademy.ac.uk/nss).

In addition to initiatives such as the Subject Centres, CETLs, the TQA and the NSS, one other national development designed to raise HE teaching and curriculum quality is particularly worth mentioning in this section on Geography, namely the QAA Benchmark. As indicated in the previous section, the QAA first started to introduce Subject Benchmark statements at the end of the 1990s. The Geography Statement was produced by a group of 14 senior HE Geography academics, many of whom were especially well known for their work in teaching and learning. Administrative and organisational support was provided by the RGS-IBG.

While careful to celebrate course diversity and to avoid being too prescriptive, the document included general guidance on the aims of Geography programmes, on the curriculum, on desirable student skills, abilities and attributes, on teaching, learning and assessment in Geography and on standards of achievement. Among other things, the statement highlighted the distinctive position Geography occupies in the world of learning because of its interest is how both social and physical processes are important to an understanding of the key geographical themes of place, environment, landscape and spatial distributions. The Benchmark statement was up-dated with only minor modifications in 2007 which, for example, emphasised the discipline's commitment to employability and Education for Sustainable Development (ESD). Not least because of the deliberately inclusive and flexible tone of the two documents, the Geography Benchmarks have not generally proved contentious; in practice one of their main uses has been to guide programme design and to help inform those responsible for programme validation and approval. Of particular interest to this thesis is the fact that although in the Benchmark support is given to the discipline's increased engagement with GIS, there is only a brief reference to GIS-at the end of a paragraph (3.10) as a way of representing the physical and human worlds. The absence of a more detailed commentary on GIS is, however, basically due to the breadth of the Benchmark document and the amount of material it had to cover. The inclusion of Professor David Unwin (one of the UK's most prominent GIS specialists) as a member of the Statements' author group should itself be seen as recognition of the growing importance of GIS. However, the lack of GIS detail means that the Benchmark is of limited specific valued to academics involved in the design of GIS curricula, although it is important to acknowledge that the same is true for the other specialist areas and sub-disciplines which commonly feature in Geography undergraduate programmes. The Benchmark operates at a more strategic, whole-discipline level.

Geography is, of course, not an academic island and many of the general pedagogical themes and issues discussed earlier (see section 2.3) have affected developments in the discipline. For example, since the mid-1990s the discipline has increased its emphasis on key skills and employability: this was in part a response to the Dearing Report (NCHIE 1997) and also to Geography's TQA national overview report (Chalkley 1996, HEFCE 1995) which identified skills and employability as an area in need of further development. As a result the Geography Discipline Network (GDN) produced a series of widely-used booklets on key skills training (Gravestock and Healey 2000, Healey 2000). More recently Gedye and Chalkley (2006) produced a GEES Subject Centre publication on promoting employability in the curriculum and there have been several important articles on this theme published in the Journal of Geography in Higher Education (see, for example, Clark 1998, Jenkins and Pepper 1988, Maguirem and Guyer 2004, Shepherd 1998) including papers on work-based learning and placements by Hogg (1995) and Chalkley (2000). Geography's strengthened commitment to employability has been assisted by two important factors. The first was that this was not an entirely new agenda: as early as 1999 Hall had reported that 47 out of 82 UK departments had already started to embed key skills into their curriculum either as a 'stand alone' module and/or by explicitly teaching and assessing skills in various Geography modules across the programme. The second was a recognition by the discipline and its staff that, given that Geography does not 'feed' one specific jobs sector, it would need to work hard at promoting its general employability credentials, particularly in an era of high student fees.

Geography has also been influenced by wider HE developments and debates in areas such as assessment and active learning. For example, in the assessment field the discipline has helped to pioneer the adoption of new techniques such as computer-based assessment (see, for example, Chalkley 1997, Weaver and Chalkley 1997) and peer- and self-assessment (Bradford and O'Connell 1998). Additionally, Hughes and Boyle (2005) addressed the issue, of aligning Geography's ILOs and students' assessments, based on the approach of Biggs (1996). In relation to active learning, in addition to conferences and workshops run by bodies such as the GEES Subject Centre, the Active Learning CETL, the Experiential Learning CETL and the RGS-IBG Higher Education Research Group, the discipline also has a well-established literature. This includes, for example, publications encouraging academics to use problem-based learning (Beringer 2007, Chappell 2006, Levia Jr and Quiring 2008, Pawson et al. 2006), inquiry-based learning (Spronken-Smith et al. 2008, Spronken-Smith and Kingham 2009) and research-based learning (Healey 1992, Walkington et al. 2011).

In addition to keeping abreast of a range of contemporary Higher Education issues, there is one area of HE teaching and learning in which Geography can reasonably claim leadership - this is fieldwork. Although some other disciplines also do a significant amount of teaching through fieldwork, (for example, Biology, Geology, Architecture and Town Planning), Geography is widely acknowledged as a leader in this form of pedagogy: 14.5%[6] of the articles published in JGHE have a fieldwork dimension (e.g. Haigh and Gold 1993, Kent et al. 1997, McEwen 1996).

Among other things, fieldwork is seen to offer deep, experiential and active learning, opportunities for linking theory and practice and the chance to develop students' research, investigative and observational skills, alongside also their personal skills such as team working and leadership. Kent et al. (1997) argued that fieldwork is often both the most effective and also the most congenial way of delivering the Geography curriculum - a view generally endorsed by more recent research and publications (Houser et al. 2011, Stokes et al. 2011, Wall and Speake 2012). Fieldwork is of

[6] This percentage was calculated by the author by searching for the fieldwork term in the title and in the summaries of articles published in JGHE.

interest to this thesis also because there has been a significant move towards the integration of Information Technology into fieldwork (France and Wakefield 2011, Maskall and Stokes 2008), not least through the use of Podcasts (Jarvis and Dickie 2010, Lynch et al. 2008), ‘virtual fieldwork’ (Butler 2008, Maskall and Stokes 2008, McMorrow 2005, Stumpf et al. 2008) and the growing use of Geo-spatial tools (GIS and GPS) by students during field course (Kingston et al. 2012).

2.5 Synopsis

This chapter has provided a basic introduction to the UK HE system and to the position of Geography within it. The chapter has therefore set out the context within which Geography-based GIS education operates. It has highlighted the substantial expansion of UK HE and its development from an ‘elite’ to a ‘mass’ system which now has about 2.5 million students. This expansion has been accompanied by a review of HE’s goals and a strengthened commitment to meeting the needs of an increasingly information-and knowledge-based economy. Alongside this increased emphasis on graduate employability, there have also been important pedagogic changes including efforts to increase the amount of active and experiential learning and to improve further the overall quality of teaching and the student experience. The discussion in section 2.3 identified a dozen key features of UK HE which are intended to underpin quality assurance and enhancement, one of the most important of which is the National Student Survey. In addition the government has invested in initiatives such as Subject Centres and Centres for Excellence in Teaching and Learning (CETLs). However both of these programmes have recently been terminated, principally because of austerity and budget cuts but also because it was difficult to quantify their actual impact on student learning.

The discipline of Geography has certainly been strongly influenced by these sector-wide developments. It has, for example, since 1960s, overall experienced a substantial increase in student numbers and it has done well in the NSS. It has also, most importantly, been actively addressing the employability agenda. In the UK Geography is not a naturally vocational discipline in that it does not ‘feed’ one particular employment sector or profession. Traditionally, there have been close ties to teaching and town planning but today many UK geography graduates enter careers which have relatively few direct links to the subject’s content or knowledge base. In order to attract future student ‘recruits’, the discipline and its departments will have to work hard at demonstrating their relevance to employability. Moreover, thanks to a new government web-site (unistats.direct.gov.uk) from September 2012 it has become much easier for prospective undergraduate to obtain course information on fees, the number of class contact hours and most importantly the employment record of recent course graduates (KIS – Key Information Sets). There are many ways in which Geography can strengthen its employability profile but GIS might provide at least part of the answer. And so, this thesis now turns its attention to the evolution and development of GIS education and to the literature on GIS teaching.

CHAPTER 3 : GIS EDUCATION

3.1 Introduction

The focus in this chapter is on issues related to Geographic Information Systems (GIS) education, which is the main theme of this PhD thesis. It provides a review of the written literature on GIS education at HE level and begins with a brief account of what GIS is and the debates about its definition. The chapter outlines the evolution and development of GIS education, mainly in the UK and USA: although there is a brief reference to Turkey, a more detailed account of developments in Turkey will be provided in chapter 9. Later sections of this chapter provide an account of the early research on GIS teaching, and topics such as curriculum development and design issues in GIS learning and assessment. Finally, the chapter concludes with a brief synopsis.

3.2 The Role and Definition of GIS

This section provides an introduction to GIS, focusing first on some basic issues related to its role, history and definition, followed by an introduction to the kinds of educational contexts within which GIS is taught in HE.

With respect to the role of GIS it has clearly become an important dimension of modern information systems. It allows people both to analyse problems by the storing, organizing and managing of spatial information and to produce solutions by investigating, manipulating, synthesizing and presenting this information (Longley et al. 2005a). Maguire (1991) has emphasized that the main reason why GIS is different from other information systems is its focus on the spatial component. The principal role of GIS is therefore to contribute to clarifying and answering socio-economic and environmental problems which have a spatial dimension (Maguire 1991). In this way, ultimately GIS can play a key part in the analysis and solving of real-world problems related to location and environment. For example, GIS is used for items as varied as "Tax Assessment" and "Environmental Monitoring" (see further details in Longley et al. 2011, pp.46-71).

A useful way of initiating discussions on the definition of GIS is to begin with an historical perspective. The emergence of GIS as a concept dates back to the mid-1960s; the term was first used by the Canada Land Inventory which was charged with finding out the potential of land resources and their use. Subsequently, the US Bureau of the Census produced a Census of Population in the first part of 1970s using GIS technology and in the UK the Experimental Cartography Unit (ECU) succeeded in conducting digital mapping of high quality towards the end of the 1960s (Longley et al. 2005). These efforts are generally recognised as representing the historic emergence of GIS.

Discussions of the GIS definition issue make up a small but important part of the GIS literature. Ever since the 1960s, specialists in this field have debated the definition and description of GIS and its concepts (Chrisman 1999, Dunn 2007, Goodchild 2004, Goodchild 1992, Longley et al. 2005a, Longley et al. 2005b, Maguire 1991, Pickles 1997, Schuurman 2000, Wright et al. 1997, Burrough and McDonnell 1998). Despite these studies, a generic definition of GIS is problematic owing to its wide range of functions and breadth of uses (Maguire 1991).

The complex structure of GIS functions and the variety of its uses make it difficult to achieve a universal consensus on what GIS means. Many researchers (Maguire 1991, Burrough and McDonnell 1998, Chrisman 1999, Longley et al. 2005a) have tried to clarify the definition of GIS through literature reviews, Delphi panels, usage groups and internet discussion lists. Maguire (1991) categorized GIS definitions into three main groups or perspectives: mapping, databases and spatial analysis. Firstly, GIS can be viewed as simple a tool for map creation through which data are fed in and processed into cartographic form. Secondly, GIS can be used to build and manage spatially-oriented databases. Thirdly, according to Maguire (1991), GIS can be seen as a science whose main function is to undertake spatial analysis by modelling and overlaying maps showing different variables or factors. In this way it can facilitate the search for patterns, correlations and explanations.

Burrough and McDonnell (1998) also have a three-fold approach to the definition of GIS but in their case the categories are: tool-box based, data-based and finally organization-based. In this way, they have identified and addressed the three fundamental kinds or functions of GIS software: coordination systems (tool-box), characteristics of spatial data (database) and the analyzing of spatial relationships (the organization-based definition).

Chrisman (1999) has conflated the views of Maguire (1991) and Burrough and McDonnell (1998) into a number of categories: the systems flow approach, the content-based approach, the toolkit approach and GIScience (the changing subject). The systems flow approach emphasises how GIS works by focusing on the internal operational processes of GIS software. The content-based approach emphasizes the aims for which GIS is being used and the field to which it is being applied, such as Urban Information Systems or Soil Information Systems. The toolkit approach highlights the key functions of GIS namely spatial overlay and spatial analysis. The final approach focuses on the changing nature of the subject and on the process of making the transition from GISystems to GIScience-a tension which is discussed later in this section. Provided below are a series of well-known definitions which illustrate and exemplify the main schools or approaches to GIS.

Those who see GIS as being essentially a system flow approach will feel the following two definitions to be especially appropriate:

> "GIS is a system for capturing, storing, checking, manipulating, analysing and displaying data which are spatially referenced to the Earth" (Department of the Environment 1987, p.132 cited in Chrisman 1999).

> "Geographical Information Systems-A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth" (Dueker and Kjerne 1989, pp.7-8 cited in Chrisman 1999).

Two key GIS definitions have been used to explain the content approach:

> "An information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data" (Star and Estes 1990, pp. 2-3 cited in Chrisman 1999).

> "In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system" (US Geological Survey 1997 cited in Chrisman 1999, p.178).

The toolkit approach highlights the main specializations of GIS such as spatial analysis and visualisation (mapping). The toolkit perspective focuses on 'doing GIS' (Wright et al. 1997). According to Chrisman's (1999) categorization, this approach is neatly summarised in the GIS vendor's (ESRI) definition:

> "A geographic information system (GIS) is a computer-based tool for mapping and analysing things that exist and events that happen on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies" (ESRI 1997).

Longley et al. (2005) have categorized the definition of GIS with respect to its various applications and the social groups who use them, as shown below in Table 3.1. However, despite Longley's range of definitions, it is important to emphasise the links and relationships between them. Indeed, the reader who looks back through all the definitions cited in this section will find that they have much in common and that the similarities tend to outweigh the differences. This accounts for the coherence and the diversity of what Haklay (2012) has recently referred to as the Geographic Information Science 'tribe'.

Table 3.1: Definition of a GIS, and the groups who find them useful
(adopted from Longley et al. 2005, p.16)

Table has been removed due to Copyright restrictions.

The final definition issue considered in this section is the relationship between GIS and Geographical Information Science. In 1992 Goodchild wrote a highly influential article entitled '*Geographic Information Science'* in which he stated that

> "it is too easy to see current GIS as a hardware and software technology in search of applications, and to see the field of GIS as defined by the functional limits of its major vendor products….GISystems are a tool for geographic information science, which will in turn lead to their eventual improvement" (p.44).

This definitional argument was subsequently much debated (Wright et al. 1997, Pickles 1997, Chrisman 1999), major themes being the rather broader scope of GIScience and that GIS alone, while a very useful tool, it not sufficient to do GIScience.

Two events were organized by the University Consortium for Geographic Information Science (UCGIS) and the National Science Foundation (NSF) in the USA to produce definitions of Geographic Information Science. These definitions have played important roles in explaining what Geographic Information Science means:

> "Geographic Information Science (GIScience) is the basic research field that seeks to redefine geographic concepts and their use in the context of geographic information systems. GIScience also examines the impacts of GIS on individuals and society, and the influences of society on GIS. GIScience re-examines some of the most fundamental themes in traditional spatially oriented fields such as geography, cartography, and geodesy, while incorporating more recent developments in cognitive and information science. It also overlaps with and draws from more specialized research fields such as computer science, statistics, mathematics, and psychology, and contributes to progress in those fields. It supports research in political science and anthropology, and draws on those fields in studies of geographic information and society" (Mark 2003, p.4).

The present position is that GIScience is commonly accepted as a broader concept within which GIS plays a major role. Interestingly, the titles Geographic Information Systems and Geographic Information Science are both used for HE degrees and module names and both are therefore considered within the scope of this PhD since in practice the curricula have substantial amounts in common. However, primarily for reasons of convenience throughout this thesis the term GIS is used (the more common label) unless the author deliberately intends to refer to the wider field of GIScience. This thesis does not "support" one approach or school of GIS/GIScience rather than another: all Geography-based programmes and modules with GIS or a similar term in the title are considered relevant.

3.3 The Emergence of GIS Education at Degree Level

Since the 1970s a great deal of energy has been devoted to the development of GIS education. These efforts concentrated initially on issues concerning curriculum design and content (Goodchild 1985, Kemp and Goodchild 1991a, Kemp and Goodchild 1991b, Nyerges and Chrisman 1989, Unwin et al. 1990): indeed, a variety of organisations have tried to develop a 'universal' curriculum model for GIS training and educational activities. These efforts have been mainly led by academics within the United States (US) and the UK.

The primary reason for initiating GIS programme and curriculum development was to meet the demands of GIS industries and user organizations (Aangeenbrug 1992a, Forer and Unwin 1999, Morgan 1987, Kemp and Goodchild 1992). These developments began with the growth of GIS education in mainstream Higher Education around a decade after the emergence of GIS as a concept and term in Canada (Longley et al. 2005), reflecting the growing spatial information requirements of the information society (Dahlberg and Jensen 1986, Forer and Unwin 1999).

One of the early models for describing the structure of cartographic and GIS education in the US was known as the ‘Pancake with Bubble’ (Dahlberg et al. 1984, Dahlberg and Jensen 1986, Jensen and Dahlberg 1983). Dahlberg and Jensen (1986) found that while some universities offered a subject dealing with the fundamental issues of cartography (the ‘Pancake’), others offered a wide range of subjects related to Cartography, Remote Sensing and GIS (the ‘Bubble’). Ohio State, the University of Wisconsin-Madison, the University of California at Santa Barbara, the University of South Carolina and the University of Washington in the US would be the examples of ‘Bubble’ programmes. On the other hand, the University of Arizona, Pennsylvania State University, Boston Washington University and Salem State College were identified as examples of the ‘Pancake’ model (Aangeenbrug 1992b).

In the mid-1980s, a special issue of the Canadian journal *Operational Geographer* became the platform where the early debates about GIS curriculum design began to be discussed. These debates focused on the content and structure of the GIS curriculum (Goodchild, 1985), the incorporation of GIS into the geography curriculum (Poiker 1985), the impact of GIS on geography (Muller 1985) and training programmes designed for GIS presentations (Maher and Wightman 1985).

Historically, the first really significant developments in GIS education were based on US initiatives in the late 1980s. One of the major advances was the development of the so called Core Curriculum, led by the National Centre for Geographic Information and Analysis (NCGIA). This was a joint project undertaken by a number of universities in the US (University of California, University of Maine and State University of New York) and supported and overseen by the NCGIA which itself was set up as a result of collaborations between these institutions (Kemp and Goodchild 1991). This project aimed to 'develop a core of material from which individual instructors will develop general introductory courses' (Kemp and Goodchild 1991, p.127). The completion of the project took two years. The Core Curriculum was composed of three parts labelled in turn: 'Introduction', 'Technical Issues' and 'Application Issues' (each having 25 lectures) (Table 3.2). Moreover, it also included a range of example educational materials appropriate to GIS teaching activities in classroom and laboratory settings (Goodchild and Kemp 1992). Initial studies conducted to evaluate the NCGIA curriculum (Kemp and Goodchild 1992, Morgan and Fleury 1993) produced rather 'mixed' results but it nonetheless had a considerable impact in encouraging the rapid spread of GIS education particularly in the US but also in the other parts of the world (Morgan and Fleury 1993).

Meanwhile, here in the UK some of the early developments in GIS education were also getting underway. The first major UK initiative in the late 1980s was introduced by the Natural Environment Research Council (NERC) and also through the Economic and Social Research Council (ESRC) by means of its programme of Regional Research Laboratories-(RRLs). The main aim was to train individuals for the emerging GIS job market (Gittings et al. 1993) and to make a contribution to a variety of fields dealing with research, education and training activities (Rhind 1987).

The ESRC in the UK fulfilled a somewhat similar promotional role to the NCGIA in the US (Unwin 1991). In addition, The Royal Institution of Chartered Surveyors (RICS), the British Computer Society (BCS) and The Association for Geographic Information (AGI) were the other main driving forces for GIS education in the UK. A particularly important milestone was a report by Lord Chorley, a geographer, (Department of Environment 1987) which provided a major impetus for expansion (Gittings 1989). This covered a wide range of issues, including "digital topographic mapping, availability of data, linking datasets, awareness, education and training, research and development, organization, and coordination – the role of Government" (Masser 1988a, AGI 2009).

Table 3.2: The structure and the content sequence of the GIS Core Curriculum developed by NCGIA (adopted from Kemp and Goodchild 1991, p. 44)

Table has been removed due to Copyright restrictions.

Another important development was a project initiated by The Royal Institution of Chartered Surveyors (RICS) through the AutoCarto Education Trust. The focus was on curriculum design and the project was undertaken by a group of leading UK academics (Unwin et al. 1990). The main aim behind this syllabus was to provide a draft framework for GIS courses offered at undergraduate level. This syllabus contained 6 sections and 37 lectures in all (Unwin 1993) (Table 3.3). Although this 'British Syllabus' was in some ways similar of the NCGIA Core Curriculum, by comparison it had some limitations such as an absence of lecture notes, laboratory activities and learning materials (Forer and Unwin 1999).

Table 3.3: Structure of GIS 'British Syllabus' developed by the AutoCarto Education Trust (adopted from Unwin et al. 1990, pp.460-462)

Table has been removed due to Copyright restrictions.

Within UK HE the provision of GIS education was initially concentrated on Masters Degree courses and Doctoral research programmes, while only a few universities integrated GIS courses into undergraduate degrees (Gittings et al. 1993). By the mid 1980s Masters level provision was getting underway at Birkbeck College, the University of Edinburgh, University College London (UCL) and the University of Durham (Rhind 1987). Among this group, the University of Edinburgh was the first university in the UK, and indeed Europe, to offer GIS at both MSc and PhD levels (Gittings et al. 1993), although the University of Newcastle, Birkbeck College, and the University of Leeds were also soon offering Doctoral opportunities. In addition, various other universities began to provide GIS courses at undergraduate level, including the University of Keele (Gittings et al. 1993, Unwin 1993), Coventry University (Unwin 1993) and Kingston University (Blakemore 1992). Another important milestone was the establishment of a research programme called *The Computers in Teaching Initiative* (Unwin et al. 1990, Blakemore 1992) based at Leicester University to support not only GIS education but also Computer Assisted Learning (CAL) in Geography more generally across UK HE. Throughout this period the Universities of Edinburgh, Leicester, Birkbeck College and UCL were among the leading institutions in the development of GIS education at HE level. A variety of related research centres (RRLs) were located in these universities by the ESRC, and this may be a key reason for their taking a leading role in the early stages of GIS development. Equally importantly, they all had strong Geography departments which included amongst their staff GIS experts and enthusiasts.

Another milestone for the development of GIS education in the UK was an agreement between the major GIS vendor (ESRI) and the Combined Higher Education Software Team (CHEST), under which GIS software with licence was offered to all UK HEIs at reduced rates. One of the most important outcomes was the establishment of the Arc software suite (previously Arc Info) as the most – widely used software in British HE. As emphasised by Kemp and Goodchild (1991), one of the most important problems facing the development of GIS education in HEIs had been the need for substantial amounts of money for a strong GIS infrastructure (principally software and hardware) but the CHEST initiative helped to reduce this obstacle (Wise 1991). This played an important part in the more rapid integration of GIS into undergraduate degrees. Besides this initiative, the emergence of the EDINA project was also an important step. EDINA is a digital spatial data provider based in the University of Edinburgh, which has enabled all relevant departments in UK HE to benefit from easy access to national digital data sets through their university server (http://edina.ac.uk). This was also an important step in the completion of the GIS education infrastructure in the UK (Field 2008).

Outside the UK and USA, the 1980s and 1990s also saw the early developments in GIS education in other countries too, particularly in other advanced western nations first and then later in the emerging industrialising countries. Examples of papers which tell this story are those by Garner and Zhou (1993) in Australia, by the GIS Education in Europe Survey (Aangeenbrug 1992a), by Bill (1992) in Germany, Switzerland and Austria, by Lobo (1992) in Brazil, and by Al-Qaydi (1999) in the Gulf States, and by Parihar (2001) in India.

When looking at the development of GIS education in Turkey (the author's country), the integration of GIS into HE began in the second part of the 1990s, and the first developments took place in Geodesy and Photogrammetry, Geology Engineering, Environmental Engineering and Planning Departments, along with a few Geography departments (the University of Istanbul being the first). Here, Geography modules associated with GIS began first to be delivered at the post-graduate level in 1996, and only two years later GIS became part of the undergraduate Geography curriculum in this department. However, despite rapid growth amongst Geography departments throughout the 2000s, Engineering and Planning departments are still the main providers of GIS in Turkish HE (Turoglu 2008), as is discussed in more detail in chapter 9.

In essence, the key factor across the globe in the emergence of GIS in HE appears to have been an increased requirement for GIS-literate staff in a variety of employment fields in both the private companies and public sector. So, GIS education was pioneered first in the USA and UK, but it is now part of HE in most countries; it is commonly based in Geography but is also found in a range of other disciplines. In some countries, such as Turkey, vocational disciplines such as Engineering and Planning have been the main providers. Wherever it is taught, however, it has to be acknowledged that the technology and innovations (such as in software development and operating systems) often take place outside the main user disciplines. Geography, for example, contributes little directly to the technology but is certainly a major user.

3.4 The Development of GIS Curriculum Models

This section looks more closely at GIS education in the US and UK, and has a particular focus on the US-based NCGIA Core[7] Curriculum and the development of the GIS British syllabus. It also provides some information on the more recent Body of Knowledge (BoK) initiative (DiBiase et al. 2006) and some comments by way of evaluating all three of these main GIS curriculum projects (Goodchild and Kemp

[7]Core has two meanings within the HE literature. The first is the most important part of something, and the second, as generally used in British HE means the compulsory part of curriculum. Therefore, here, it has been used with the first meaning.

1992, Kemp and Goodchild 1992, Kemp and Goodchild 1991a, Kemp and Goodchild 1991b, Kemp et al. 1992, Unwin and Dale 1990, Unwin et al. 1990).

The most important reason for developing the NCGIA model curriculum was to help lecturers to design and select their own course contents. The development process had three main stages: the creation of a draft version, its evaluation, and then subsequent dissemination of the revised version. The first draft was based mainly on modules delivered in the Department of Geography at the University of California at Santa Barbara (UCSB) (Kemp and Goodchild 1991b). Its key component was a 75-lecture outline. This draft was sent for comment to 60 academics in different countries, though most were from the US or the UK. Thirty-five out of the 60 specimen provided materials. The curriculum was completed based partly on these experts' reviews and teaching resources (Kemp and Goodchild 1992).

The second main step in the development of the NCGIA core curriculum was its full evaluation which took almost one year. The 71 HEIs involved were located in the USA, the UK, Australia, New Zealand and Hong Kong (all English speaking). The overall satisfaction ratings were quite encouraging (with a mean score of 3.8 out 5) and so, following further discussion, the finally agreed Core Curriculum was published in 1989 and dissemination followed soon afterwards. The final version was requested by 428 HEIs from 49 countries. Of these 428 HEIs, the majority were based in the US (197), the UK (48) and Canada (39). Only an English-language version of the NCGIA curriculum was available at that time, which was probably a key factor which affected the level and the geography of demand (Goodchild and Kemp 1992, Kemp and Goodchild 1992, Kemp and Goodchild 1991b).

In years after the publication of the GIS Core Curriculum, some other important curriculum development projects were also undertaken by NCGIA. These new projects covered a wide range of related topics such as a Remote Sensing Core Curriculum (RSCC), a Core Curriculum in GIScience (GISCC) and a Core Curriculum for Technical Programmes. These curricula were published online at the end of 1997 (Kemp 1997, NCGIA 1997). Figure 3.1 provides a time chart for a number of the more important GIS curriculum statements.

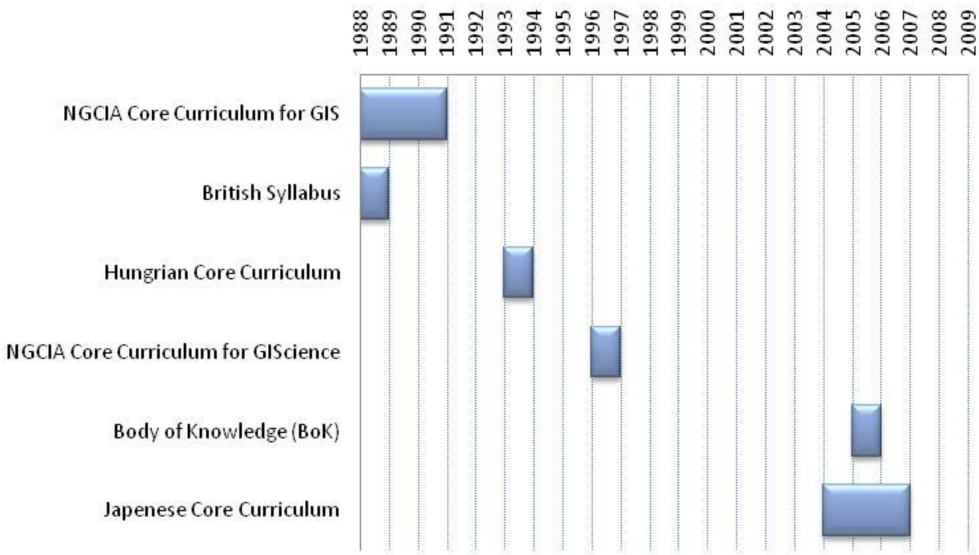


Figure 3.1: The historical development of GIS curricula projects in various countries

As mentioned in the previous section, the major UK-based curriculum was the so-called British Syllabus for teaching GIS (Unwin et al. 1990). This was designed under the auspices of the Educational Trust Fund of Autocarto in association with the Royal Institution of Chartered Surveyors. The development of the Syllabus was a direct response to the needs of the UK educational community who wished to integrate GIS into their degree programmes. The syllabus was designed by nine GIS specialists following discussions at a symposium held in Leicester, the key figure being Prof. David Unwin. It consisted of six main sections and 37 different lectures. Unwin (1997) defined a syllabus as comprising a course title and list of course contents or lecturing materials. However, as emphasized by Gold et al. (1991a), a full curriculum should also consist of aims and objectives, assessment and teaching methods, with each part being consistent with the others. (This may be the reason why Unwin used the term syllabus rather than curriculum.) Essentially, the British Syllabus comprised a list of recommended topics and a reading list, there being very few text books at the time around which a module or programme could be designed.

It is not surprising, therefore, that although the British Syllabus and the NCGIA Core Curriculum covered broadly similar ground in terms of subject content, it was the latter, supported by helpful teaching resources and exercises, that had the wider impact. By 1997, no less than 1500 copies of the NCGIA document had been distributed across 70 countries, in some cases the whole document being translated into the native language (Kemp et al. 1992). This was, for example, the case in Hungary where instructors were specifically trained to deliver the Core Curriculum (Markus 1993). Zietsman (2002) also noted that most of the GIS curricula being implemented in Africa were partly or completely adapted from the NCGIA Core Curriculum into University modules. In addition, the Geographic Information System Association of Japan (GISA) produced curriculum guidance for Japanese Universities which was very much based on the NCGIA model (Kawabata et al. 2004 cited in Sasaki et al. 2008). So, although in many countries and Universities, a lack of facilities (software and hardware) and insufficient staff expertise meant that very few HEIs attempted to introduce the whole NCGIA model, nonetheless Heywood (1990) concluded that the NCGIA initiative was a particularly important and influential project.

Another major and more recent US initiative is the Model Curricula project of the University Consortium for Geographic Information Science (UCGIS) in GIS Education, namely the Geographic Information Science and Technology (GIS&T) Body of Knowledge (BoK) (DiBiases et al. 2006). The first copy of the project was published in liaison with the Association for American Geographers (AAG) in 2006. The project was initiated in part because the NCGIA core curriculum (despite amendments) was increasingly out-dated (Prager and Plewe 2009). The aim of the BoK project was to help academics and organizations to design and evaluate their GIS courses in terms of objectives, structure and Intended Learning Outcomes (ILOs). The BoK includes 10 knowledge areas, 73 units, 329 topics, and no less than 1,660 formal educational objectives or outcomes (DiBiases et al. 2006). Twenty-six units (out of the 73) were defined as core in the BoK, meaning that they were considered of central or special importance.

A number of studies recently have discussed the value and applicability of the BoK. For example, Prager and Plewe (2009) have reviewed GIS modules in two US universities with reference to the BoK. They welcomed the focus on ILOs but noticed some weaknesses within the BoK, including missing topics within units. Secondly, Demers (2009) has analysed the action verbs used in the BoK attainments, using the original version of Bloom’s Taxonomy (Bloom et al. 1956), and found that in 9 out of the 10 knowledge areas almost all the action verbs used in the ILOs represent the Comprehension and Application levels (Bloom’s level 2 and 3). Only one of them embodied high-order thinking skills (application and analysis).

So, the discussion in this section has traced the history of the three main GIS curriculum projects offering guidance on the scope and content of GIS education (Figure 3.1). All have been influential, although their breadth often meant that individual academics needed only limited parts of them in designing their curriculum. Overall, with the passage of time, the NCGIA and the British Syllabus have inevitably lost much of their initial importance. With its focus on ILOs, the BoK certainly seems more aligned with modern thinking on curriculum design. However, given that across

320 topic areas it lists no less than 1660 education objectives or outcomes, the BoK could be accused of being too detailed. Moreover, given that there are now more than 100 text-books on GIS, one wonders how much attention academics now give to documents such as the BoK when designing GIS courses and curricula. The results of this research thesis (chapters 5-9) will shed some light on this question.

More immediately, however, our attention now turns to a review of the literature on GIS teaching and learning. Having focused on the three most significant documents on overall curriculum design and coverage, it is time to consider what can be learned from the existing education and research literature on the actual practice of GIS teaching, learning and assessment.

3.5 Developments and Issues in GIS Teaching, Learning and Assessment

Although, as outlined above, much of the early literature on GIS education had a focus on curriculum development and subject content, over the years there has also developed a literature on methods of instruction for GIS (DiBiase 1996, Kemp and Unwin 1997). In the UK this interest in researching and writing about GIS teaching was encouraged by the work the Centre for Excellence in Teaching and Learning in Spatial Literacy in Teaching (SPLINT). SPLINT was funded (£3.9 million) by the Higher Education Funding Council for England (HEFCE) from 2005-2010 and focussed on the pedagogy of geospatial technologies. It was a collaborative project involving the University of Leicester, the University of Nottingham, and University College London. It worked closely with Geography but also with other disciplines such as Engineering and Town Planning which use GIS. Its areas of interest included, for example, the use of 3D visualisation and location-aware mobile computing. Details of SPLINT's publication lists and events can be found at the website (http://www.le.ac.uk/geography/splint/). It will be interesting later to see how far SPLINT's work has affected teaching in the thesis case-study departments.

In SPLINT's early phases (2005-2007), they placed an explicit emphasis on GIS teaching and curriculum issues and helped produce a free-supplement[8] under the auspicious of JGHE (Tate and Unwin 2009). However in the last three years they placed more emphasis on using "spatially-aware" mobile technologies and the development of applications for effective uses of these tools as well as the enhancement of fieldwork experience with multi-media technologies (e.g. podcasting in fieldwork). Across its full five year-funding period SPLINT also organised many events, workshops and seminars to disseminate the results of their work, sometimes in collaboration with HEA-funded initiatives such as the GEES Subject Centre. Although SPLINT-CETL's chief remit was to "strengthen spatial literacy in the UK Higher Education" (LeGates and Kingston 2008, p.3). In practice, much of its work focussed on local initiatives within the three host institutions and their Masters programmes and UG-level GIS provision. It is interesting that HEFCE's final assessment report (HEFCE 2011) about the 74 CETLs across the UK found generally many of the CETLs did not make much impact outside their host institutions.

Although GIS teaching is obviously a specialist field, it is also true that it does not exist in isolation and is obviously influenced by wider developments in pedagogy both in HE generally and also particularly in Geography. The kind of issues discussed earlier in sections 2.3 and 2.4 therefore are (potentially at least) relevant to GIS. For example, these include the shift in emphasis from teaching to learning, the development of student-centred approaches, and the opportunities for computer-

[8] http://www.tandfonline.com/toc/cjgh20/33/sup1

aided learning (CAL), research-related teaching, problem-based learning, experiential learning and the development of students' transferable skills and employability. Again, it will be interesting when discussing the findings from the case-study departments (chapter 5-9) to consider how far these major trends discussed in the general literature have made a difference to the teaching of GIS.

There are, of course, a number of themes and issues which strongly stand out in the specific literature on GIS teaching. Perhaps the most prominent is the debate about GIS theory and practice. The teaching and learning activities based in classroom and lab settings are obviously a centrally important part of GIS education (DiBiase 1996, Forer and Unwin 1999, Green and McEwen 1990, Longley et al. 2005a, Unwin 1991, Walsh 1992, Wikle 1991, Foote 1997, Clark 1991) despite raising challenges for the lecturers (Wikle 1991, Unwin 1991) and sometimes for the students (Deadman et al. 2000). One of the key themes in the literature is that students generally enjoy the practical side of GIS and learning about particular techniques in the laboratory. However, they are less enthusiastic about the GIS theory which is often taught in lectures. The academics, by contrast, generally believe that GIS should be more than a set of skills and simply learning to press buttons in the right order; and because GIS software and skills requirements change so frequently in the workplace, it is important that students understand the general principles and theory.

This theory/practice debate is nicely summarized in the quote below from Goodchild found in Clarke (2003, p.303).

> "It is very important to find the right balance between an education, which gives an understanding of the underlying theory and concepts, and training in the use of specific packages. Both are necessary, because theory and concepts can be very dry without the hands-on experience that GIS is really all about, but if there is no theory to provide context, the best training in the world can be useless in the long term."

It is noticeable that compared to teaching about software packages and applications, there is very little work published on how to teach GIS theory, despite the view expressed by Srivastava and Tait (2012) that learning the basic principles should underpin the more student-centred and experiential learning in practicals. Perhaps the lack of literature on teaching GIS theory is because of the belief that theory can only be delivered by traditional lectures (although a recent work by Schultz (2011) offers a few examples of how to integrate more innovative methods into theoretical classes in GIS). In addition, as Diabiase (1996, p.64) reminds us: “The lecture format endures because of the economic advantages that accrue from large student/teacher ratios and the smaller investments required for equipment, supplies and, perhaps, preparation”.

Another important theme in the literature on GIS teaching is computer-assisted learning. One of the early pioneers was Green (1987) who worked on Arc/Demo and on concepts which were later taken forward by Raper (1991, 1992) who with colleagues produced two different versions of the Geographical Information Systems Tutor (GIST I and II). These kinds of projects were later improved by using other multimedia tools (Deadman et al. 2000, Grunwald et al. 2007, Zerger et al. 2002) and the internet (Carver et al. 2004, Johnson and Boyd 2005). The main philosophy behind these studies was to attract more students, who learn in different ways, including distance learning GIS (Unwin 2011 , Wright and DiBiase 2005, Wright et al. 2009). One of main GIS vendors also produced somewhat similar tools; the so-called ESRI Virtual Campus has more than 300,000 users across the world (Johnson and Boyd 2005). Another issue, which was addressed by Grundwald et al. (2007), is the easy-update feature of digital-systems when compared to textbooks, particularly for GIS which is a rapidly changing subject.

Given the importance in GIS of practicals and applications teaching, it is not surprising that there is a considerable literature on integrating student-centred approaches, principally problem-based learning (PBL), project-based learning, inquiry-based and experiential learning (Benhart 2000, Carlson 2007, Chen 1998, Clark et al. 2007, Drennon 2005, Elwood 2009, Fraser 2005, King 2008, Livingstone and Lynch 2000, Read 2010, Solem 2001, Wilder et al. 2003, Huang 2011, Mountrakis and Triantakonstantis 2012). Indeed, PBL is one of the most widely used methods in GIS teaching (Bednarz 2004). Therefore Drennon (2005) and Read (2010) have suggested that the practical aspects of GIS should be designed according to problem-based learning and/or project-based strategies, so that students not only improve their technical skills (mainly GIS-oriented), but can also develop a wide range of transferable skills (e.g. team working, problem solving etc.). Similar ideas have been echoed by Wilder et al. (2003), Huang (2011) and Chen (1998). However, as pointed out by Kemp et al. (1995), Solem (2001) and Fraser (2005), these approaches work best where the students already have an understanding of the software before they are asked to use it in problem-based applications.

Another aspect of teaching which can link to GIS is, of course, fieldwork, which as discussed earlier (section 2.4) is widely considered to be a very effective form of experiential and active learning (Kent et al. 1997, Haigh and Gold 1993). Carlson (2007) has emphasized that fieldwork can benefit from data collection techniques such as GPS and that teaching GIS in combination with fieldwork can be very productive, although logistically this can be difficult with large student numbers. The linking of GIS and field teaching nicely illustrates the potential for “teaching about

GIS" (as a GIS module) and also "teaching with GIS" (perhaps using GIS in other modules) (Sui 1995, Thomson 1987).

Although assessment is now seen as playing a key role in Higher Education and the concept of "assessment for learning" (Brown 2004, p.81) has wide support, very little has been published about assessment in GIS. The only recent article of note is that by Erlien (2011) who suggests that "writing-intensive" GIS coursework can help students to improve their GIS knowledge.

Other authors, such as Brown (2004) have written more generally about the employability of Geographers skilled in GIS, and Whyatt et al. (2011) have conducted an alumni study of former Geography students who had taken a GIS module. Of the 137 study participants (a 26% response rate) 22% were in posts which centrally involved GIS and a further 41% were in jobs where an appreciation of GIS capabilities and software was occasionally useful. The students' experiences suggest that learning how to use specific GIS software is vocationally useful in the short term but that because of software obsolescence it is the broader understanding of GIS principles which has long-term value. Given that students in GIS-related jobs were probably more likely than other students to respond to this questionnaire survey, Whyatt et al. (2011, p.242) conclude by saying that overall, "For many alumni the GIS module had little discernible effect, for several a modest one and for a few it shaped their careers".

3.6 Synopsis

This chapter has presented a review of the GIS education literature which has focussed on teaching GIS at University level. The literature shows that English-speaking countries (mainly North America and the UK) played the dominant role in the emergence and early development of GIS education which was mainly a response to the need to meet the growth of the GIS jobs market. Initially, much of the literature focussed on model GIS curricula but more recently there has been more interest in writing about how to teach GIS. Among the key themes in this literature are: the balance between teaching GIS theory and practice, the use of computer-assisted learning to attract non-traditional (e.g. distance learning) students, the growing use of student-centred approaches such as problem-based learning, and the role of GIS teaching to promote transferable skills and employability.

This chapter’s review will be used later in the thesis to help place the PhD results in context. It has also been useful in helping to show gaps in the literature. For example, most existing studies focus on one particular aspect of GIS (such as a piece of software or an approach to problem-based learning). This thesis, however, is different because it takes a wider view to look at many different aspects of GIS teaching in a more holistic way. In the case study departments it provides a more rounded view of the GIS provision and especially the student learning experience as a whole. It will touch an aspects which have often been ignored in the literature (such as assessment) and will above all provide a more complete picture of GIS teaching and its main characteristics, strengths and weaknesses.

Having now reviewed some of the main themes in the existing literature on GIS education and teaching, the next chapter will explain the research methods used in this PhD programme and outline the work which was undertaken to address the key thesis aims.

CHAPTER 4 : RESEARCH METHODS

4.1 Introduction

The research presented in this thesis has been designed to meet the aims set out in chapter one. These relate principally to achieving an understanding of GIS provision, pedagogy and student employability in UK and Turkish Higher Education. The focus is on courses provided by Geography departments (or similar sections or units). In order to meet the thesis aims it was obviously important to design a research strategy and to use research methods which would provide the relevant data. The purpose of this chapter is therefore to describe, explain and review the research methods used, while also acknowledging that there were inevitably some constraints and limitations.

The discussion begins with the methodological influences which shaped the overall research design (section 4.2). Methodology is an umbrella term which deals with the general "principles of inquiry" (Wolcott 2009, p.87) which provide a rationale and framework for the selection of particular research tools which were in this case, for example, documentary sources, staff interviews, student questionnaires and classroom observations. Having outlined the author's general rationale for the overall research framework, the next section (4.3) deals with the reasons for choosing a case-study approach, with six UK and four Turkish departments providing the main sources of data for the thesis. The next three sections (4.4, 4.5 and 4.6) consider the research tools used in exploring in turn the main areas of investigation, which were GIS provision, pedagogy and employability. In each of these sections, in order to give more detail to the broad overall thesis aims, the text sets out the particular objectives to be examined and the precise methods used to explore them. Then there is a brief account of how the Turkish research was a little different from that in the UK (section

4.7). The UK and Turkish surveys had essentially the same aims and so very similar methods and sources were used, but there were some small differences relating, for example, to the kind of course documents available in the two countries. Finally, the chapter closes with a synopsis which reminds the reader of the range of sources used in this research and highlights the strengths of the methods deployed while recognizing also some of the problems encountered.

4.2 Methodology: Research Paradigm and Perspectives

A research paradigm is a group of related ideas about the nature of the world and the role of the researcher which is believed in by a group of researchers and which influences their pattern of thinking and work (Bassey 1999, Pratt 2011). Two main paradigms have helped design the research undertaken in education and more widely in the social sciences as a whole. The first is the positivist perspective which considers the social world as a tangible, external and objective reality which is best studied by scientific investigations (typically quantitative) which mirror the methods of the natural and physical sciences. The positivist paradigm generally adopts research designs which use hypothesis testing, experiments and numerical analysis. Its supporters tend to focus their work on what can be measured. The main concern is to ensure that observations are accurate, consistent and can be checked (perhaps by repeating the investigation or experiment).

The second main paradigm is known as interpretivism which sees the social world as the creation of individuals and communities with their own subjective values, experiences and opinions. Pratt (2011, p.3) explains the difference between interpretivisim and positivism by underlining the fact that with interpretivism “the focus is not on demonstrating causal relationships through experimentation, but on offering explanations through careful examination and interpretation of events”. As a result, it is possible to reveal the processes influencing human behaviour in any part of social life. The interpretivist paradigm has the assumption that the social world is very different from the natural world because the reality of each individual's experience has meaning. People see the world from different points of view and so social researchers need to allow for different interpretations and explanations of events. In an education context, for example, academics, students, University managers and graduate employers will all interpret their experiences differently. There is no single, objective reality but instead a variety of experiences which an interpretivist approach can help to understand. This approach is well summarised in the following quote:

> "The social and educational world is a messy place, full of contradictions, richness, complexity, connectedness, conjunctions and disjunctions. It is multi-layered and not early susceptible to the atomisation process inherent in much numerical research" (Cohen et al. 2007, p.166).

The two paradigms outlined above are often discussed also under the headings of quantitative (positivist) and qualitative (interpretivist) research (Cohen et al. 2011, Cousin 2009). The quantitative approach supports large-scale studies with lots of numerical evidence and plenty of opportunities for measurement, hypothesis testing and statistical analysis. Although quantitative research has a long tradition in the physical and natural sciences, since the 1960s it has also occupied a substantial place in the social sciences and disciplines such as Geography which in the late 1960s and 1970s went through a "quantitative revolution" (Sidaway and Johnston 2007). Education Sciences also underwent similar changes (Stierer and Antoniou 2004).

In contrast to quantitative research, qualitative approaches tend to support small-scale but deeper studies which try to reach the real core of events and problems through research which concentrates on individuals' accounts, interviews, biographies and forms of observation which allow the situation under study to be as normal and naturalistic as possible (Flick 2002). The main characteristics of both qualitative and quantitative research are outlined in Table 4.1.

Table 4.1: The main characteristics of qualitative and quantitative approaches
(adopted from Merriam 1998, p.9)

Table has been removed due to Copyright restrictions.

Obviously both quantitative and qualitative approaches have their strengths and weaknesses and their actual value depends on the particular research topic and the costs and benefits of using particular methods and data sources. Traditionally, many social researchers and policy makers, including those studying educational issues, have liked the apparent objectivity and rigour of the positivist paradigm (Greenbank 2003). However, in recent years, there has been a growing awareness of the limitations of positivism and so a recognition that numerical trends do not necessarily provide good explanations. Qualitative methodology is often seen as a valuable way of exploring “life as it is lived, things as they happen…...the course of events” (Woods 1999, p.2). A case study approach, for example, can therefore produce richer evidence than a large-scale statistical survey, although, of course, case studies may be not fully representative and it may be hard to generalise from them.

The fact that both quantitative and qualitative approaches have their merits has led recently to an increased interest in “mixed methods” (Bergman 2011, Harrits 2011). The contribution of qualitative and quantitative approaches allows the research to benefit from their strengths while offsetting their weakness (Bryman 2006, Bryman 2008). Critics of this mixed approach highlight the danger of philosophical inconsistencies and, above all, the extra work and wider range of skills required to do research using both approaches (Creswell 2003, Molina-Azorín 2011). Nonetheless in designing the research presented in this thesis the author decided to adopt what is essentially a mixed method approach.

There were three main reasons for this. First was the desire to obtain the benefits of both approaches: the rigour and objectivity of statistical analysis plus the insights coming from a small number of personal interviews with GIS teachers. Second was the opportunity to compare and triangulate the results from different kinds of sources: this increases the validity of the research findings (Bryman 2008). And thirdly, using a mixed methods approach developed my experience and skills in a wider range of research tools. As explained in section 1.3, under the terms of my research grant from Turkey, my PhD training should be used to increase my skills so that I can return to Turkey ready to be a good academic. So a research programme combining qualitative and quantitative methods would be most helpful.

The information on the research design outlined in the next sections therefore has both qualitative and quantitative aspects. For example, on the qualitative side there is the use of case-study departments, the interviews with a small number of GIS staff and GIS employers and the classroom observations of teaching. These provided the opportunity for ‘rich’ and ‘thick’ description of how GIS is taught and its relevance to the workplace. The use of larger-scale more quantitative approaches is in the national data gathered on the provision of GIS education and more especially by the two student surveys (213 respondents in the UK and 145 in Turkey) which provided data for numerical analysis. Overall this combination of approaches added to the quantity, variety and quality of the data obtained and also widened my research experience. It made the research more time-consuming and difficult but also more worthwhile and interesting.

4.3 Research Through The Case Studies

The main foundation for this research is six UK and four Turkish Geography departments which do teaching in GIS. These case study departments (CSDs) are central and so it is important here to introduce briefly the case study approach generally in social research.

The case study method is identified by Creswell (2007, p.97) as “a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases), through detailed in-depth data collecting involving multiple sources of information (e.g. observations, interviews, audio-visual material, and documents and reports)”. However, as underlined by Gillham (2000) the case study method need not be all qualitative and can benefit also from including quantitative research techniques (Cohen et al. 2011, Merriam 1998, Stake 1995, Yin 2009). In this respect, this PhD research used both qualitative methods (for example, interviews with the GIS module leaders) and also quantitative methods (for example, student questionnaires).

The particular form of case-study research used for this thesis was essentially “multiple case study design” in which important extra benefits came from relying not on a single case but from collecting data from a number of cases. This increases the size of the evidence-base and makes possible comparison between different types of case and in this research between the UK and Turkey. Given that in total ten Geography departments were involved in the study, no attempt is made to present in turn a complete profile and review of each department with a discussion of its individual survey results. This would not only be repetitive for the reader, it would also increase the risk of the departments being readily identified thereby endangering confidentiality. Instead, the analysis focuses on themes and issues across the CSDs.

The literature on the case-study approach refers to many different types of case-study research including descriptive, interpretive, instrumental, collective and evaluative (Cohen et al. 2011, Merriam 1998, Stake 1995, Sturman 1999, Yin 2009). The last of these labels is particularly relevant to this GIS thesis because the thesis tried to evaluate GIS provision and to obtain teaching and learning lessons from the findings obtained. The final chapter includes a list of recommendations and, given the international nature of this research, there is an interest also in what the two countries, the UK and Turkey can learn from each other.

4.3.1 Selecting the UK case study departments (CSDs)

Although the case-study approach has many benefits in terms of depth, there is the danger that the case study (ies) (CSDs) chosen may not be typical. While statistical generalisation to a population was not the aim of this research, the multiple-case design helped to minimise the risk of bias, as did the care with which the CSDs were selected. This was assisted by the typology of Geography departments set out in section 5.2.4 which helped to ensure that the CSDs did not all come from the same groups or categories. In choosing the UK departments a number of factors were taken into account. Most important was the need to cover all three types of provision, namely GIS modules within Geography undergraduate degrees, GIS Masters programmes and full undergraduate programmes in GIS. A web-based review helped to identify the institutions which offered these various types of provision and made clear that GIS modules within Geography degrees were by far the most common form of provision (see section 5.2).

A second selection factor was the need to achieve balance between old and new (post 1992) Universities. As indicated earlier (see section 2.2) the former Polytechnics have a long-standing commitment to more vocationally-oriented courses and teaching (Haigh 1985, Unwin and Dale 1990). So, it was thought interesting to check for any similarities and contrasts in GIS provision and teaching between the old and new Universities.

A third selection factor was practical. Plymouth is located in the far southwest of England at considerable distances from most of the UK's other major cities and centres of Higher Education. Given the research project's limited budget and the need to fund also the Turkish studies, finance was an important factor in terms of travel fares and overnight accommodation (typically two or three nights away per institution visited). There were advantages therefore in choosing departments where it would be possible to study more than one type of GIS provision (for example, both a Geography undergraduate degree and a GIS Masters). It is recognized, of course that this could carry a risk of "elite-bias" (Miles and Huberman 1998, p.41) in favour of institutions where GIS is strongly represented but the financial constraints were tight and it is anyway a fact that Geography-based GIS Masters are always run in institutions which also have undergraduate Geography courses. The final practical factor in selecting CSDs was the advantage in having a previous contact with somebody in the department (preferably a GIS lecturer) who could be the link person. This approach is in line with the advice given by Stake (1995, p.4) who says that "if we can, we need to pick up cases which are easy to get to and hospitable to our inquiry". Stake (1995, p.57) says that this also important because "most educational case data gathering involves a least a small invasion of personal privacy".

Taking into account all the above factors, the UK side of this PhD research was focussed on six departments (in three old and there new Universities) which between them offered six undergraduate Geography programmes, three GIS Masters courses and one full GIS undergraduate course. Bearing in mind the overall national pattern of GIS provision (see section 5.2.4), this was considered a reasonable balance. It involved a workload commitment which was reasonable while producing the quantity and quality of data needed for this PhD thesis particularly given the added work of the Turkish study. No UK department approached to participate declined to do so. Although there was no formal refusal, two failed to reply to my e-mail and follow-up enquiries. In terms of factors such as their size, status and overall curriculum there was nothing clearly atypical about the departments finally chosen. Given the above discussion, their selection seemed justifiable and appropriate.

4.3.2 Working with the UK case study departments (CSDs)

In order to produce the co-operation of the CSDs and to maintain good relations with them, this research was designed to obtain the data considered essential but to do so with a "light touch". It was important not to be a burden or nuisance to the hosts or to stray into material which might be considered sensitive or even confidential (unless they wanted to show). So, in terms of documentary sources, principally public information was used such as programme specifications and student handbooks, but data such as student evaluations, examinations results and external examiners' reports were not sought. It was important to have the goodwill of the CSDs and in particular the staff member(s) responsible leading on GIS. This ensured that the key parts of my investigations were completed successfully, namely the staff interviews, the student questionnaire surveys, the classroom observations and the access to the basic course documentations.

The relationship with the CSDs and all the research participants was also governed, of course, by ethical considerations. Details of the research questions and methods used had to be approved by Plymouth University's research ethic procedures. A key factor here was participant anonymity and the confidentiality of the individual staff, student and employer respondents. This helped to give participants the confidence to provide accurate and honest information. All knew in addition that they were able to withdraw from the study at any time. In this thesis the CSDs are given only a number and are not named. The efforts to give anonymity ensured that participants could not be easily identified. This also helped to reduce the moral and personal difficulties of possibly having to make critical or negative comments or evaluations on a department which had kindly hosted my visit. This kind of dilemma is not unusual in case study research.

Generally relationships with the CSDs worked well. This was assisted by my non-intrusive approach and by my sharing at a general level and informally some of the key findings from their own student surveys. The GIS staff seemed to enjoy the chance to talk about their work. The only difficulty came when a staff member offered to get a few extra student questionnaires (to improve the response rate) after my visit. Despite a few reminders, these did not arrive and it became clear that the staff member was unhappy about my pressing them on this matter. This for me underlined the importance of generally taking a "light touch" approach and of recognising that academics are busy and have many other things to do in their jobs.

4.4 The Research on UK GIS Provision

The research on GIS provision was planned to meet the following main objectives:

- To outline the provision of GIS teaching at undergraduate and taught post-graduate levels within geography departments in UK Higher Education.
- To develop a GIS provision typology.
- To show the spatial distribution of HE GIS provision across the UK.
- To obtain insights into the CSDs' GIS curricula and the related ILOs and to assess their alignment with international programmes of curriculum development such as the BoK.

The sequence of the research began by finding out that there were 87 Geography departments (or sections/units) across the UK and the first part of study included all of them. The next step was to check using the Web that these departments were indeed currently offering Geography (and/or GIS) degree programmes. This data presented in chapter 5 had to be collected near the start of this research period (2009-summer), but based on conversations with GIS lecturers and the RGS-IBG; there have not been major changes since.

The relevant web-pages of Geography departments were examined in order to collect information about the title of GIS modules and GIS degree programmes (both at undergraduate and postgraduate-taught level). In this process, Geography modules with titles that had 'GIS' related terms (such as GIScience, Spatial Analysis etc.) were also identified and included for the research.

The results of this investigation were used to answer the question: to what extent do Geography Departments have GIS provision at undergraduate and postgraduate levels? The data also shed light on the spatial pattern of GIS provision. This was shown by mapping the courses and modules, using GIS (see section 5.2.4). The analysis of the spatial distribution of GIS provision was used to shed some light on what factors might help to explain its geography (although this was not a major concern in this research). The level of GIS provision and the number of GIS Geography modules were tabulated for each department. This was used to develop a mutually-exclusive typology of Geography Departments based on the nature and scale of their GIS provision (see section 5.2). Each type represented was a particular class or mix of GIS provision. This typology was used to help guide the selection of the CSDs.

Another main concern about GIS provision was to provide in the CSDs a review of the curriculum and to find out what kind of GIS was offered in terms of its academic content and scope. For this analysis, programme specifications and module handbooks were mainly used (plus, if available, hand-outs and practical sheets). This section also focused on the technical and laboratory support for GIS in the CSDs.

The curriculum analysis process was mainly qualitative and included reviewing how far the contents reflected the BoK. No detailed coding techniques were used in this process, but general themes and key concepts were used to make a “similarity” and/or “familiarity” analysis against the BoK contents (see section 5.3.3). This approach has been employed by other researchers (Prager and Plewe 2009, Demers 2009). Interviews with the GIS academics (see section 6.3) also provided some insights into the curricula design process.

4.5 The Research on UK GIS Pedagogy

The main research objectives in the GIS pedagogy section were:

- To review the balance between GIS theory and GIS practice in the actual teaching of the GIS curricula.
- To obtain GIS students' opinions, to critically examine their learning experiences and to review the ways in which students acquire GIS skills and knowledge.
- To explore issues about GIS staff backgrounds and the staff views on GIS education-related issues (such as teaching and learning methods and innovation).

The pedagogical aspects of GIS have several ingredients: the aims, Intended Learning Outcomes (ILOs), the teaching-learning process (teaching methods, activities, materials and assessment), and the sequence of content (Gold et al. 1991b, Jenkins 1998). Within the CSDs a variety of methods were used to examine how the curriculum was delivered and taught, including interviewing lecturers, surveying students, making classroom teaching observations and collecting documents such as module handbooks, hand-outs and practical activity sheets. The use of a variety of information sources made triangulation possible so that it was possible to cross-check the main assertions and findings (Hayes 2006, Woods 2006), comparing, for example, the views of students and staff.

4.5.1 The staff interviews

A total of 11 semi-structured interviews were conducted with either GIS module leaders or GIS programme coordinators. The semi-structured interview is one of the most widely used tools in education (e.g. Zamorski 2002, Pill 2005, Kreber et al. 2005). Its key advantage is that it offers a balance between consistency and flexibility. The use of essentially the same questions in each interview provides a consistent framework and assures that basically the same ground is covered each time. However, the semi-structured approach provides also an opportunity for flexibility in that the interviewer is free to ask supplementaries in order to enquire into particular issues which arise during the interview and which in the case of this research might shed extra light for example on GIS teaching in a particular CSD (Hay 2000).

The GIS interview schedule (Appendix 1) was deliberately prepared in accordance with the general principles set out in the literature on semi-structured interviews (see for example, Blair et al. 1980, Kvale 1996, Oppenheim 2000, Gillham 2005, McNamara 2009 and Cohen et al. 2011). For instance, it is clearly good practice to ensure that the questions posed relate closely to the overall research aims and that they address the key topics at the heart of the research programme (Gillham 2005). In this case, the interview schedule was divided into four main parts. The first was about GIS provision and the lecturers' professional backgrounds. The second and third parts focused on questions related to the curriculum, teaching, learning and assessment: for example, in part 3 question 6 asks what assessment methods they use and why. The fourth main part of the interview schedule addresses issues related to employability. The scope and coverage of the schedule therefore spans all the key thesis areas for investigation, namely GIS provision, pedagogy and employability.

Another important design principle referred to in the literature is the importance of appropriate opening and closings. Oppenheim (2000), for example, highlights that the first main questions should be deliberately non-threating and should put the interviewees at their ease and make them feel comfortable. The first part of my schedule therefore asked about their professional backgrounds (Q1) and about how they came to be interested in GIS teaching (Q2). My impression was that they liked talking about themselves and felt rather flattered by my interest. This gentle opening helped to establish a rapport and made it easier to ask more challenging questions later, for example, about their understanding of the NCGIA and the Body of Knowledge (Part 3 Q2) or about their use of the Geography Benchmark statement (Part 3 Q3). In closing the interviews Oppenheim (2000) suggests that it is good practice to invite the interviewee to add anything else they consider important to the study but which they have not so far had to the opportunity to mention. My brief closing section (Part 5) therefore included a question “Is there anything else you think it would be helpful for me to know?”

Not surprisingly, one of the other key messages found throughout the literature on interview design is the importance of avoiding ambiguity and bias (Arskey and Knight 1999 and Kvale and Brinkmann 2009). With this in mind, my questions were worded to avoid confusion and used simple language and expression, while generally inviting a richer response rather simply a “yes/no” answer. For example, in the employability section (Part 4) Q2 asks “Do you think that GIS students’ knowledge and skills are good enough to get a GIS job?” While this question is straightforward, all the respondents provided quite subtle and complex answers referring, for example, to important differences and variations within the GIS job market. The questions used in the schedule were therefore designed to be clear and simple but could nonetheless, where needed, produce rich answers. They also used neutral language to avoid any danger of subtly leading the respondents towards a particular answer. Phrases such as “Do you agree that….?” were therefore avoided. The interviews went well but the analysis and transcription process was time consuming. The interviewees were happy for our conversation to be recorded which meant a lot of transcription work but had the advantage that, if necessary, the records could be listened to again and again.

These face-to-face interviews could be considered a time-consuming and expensive data collection tool, but it was very suitable for this kind of research, not least because nowadays the alternative of perhaps electronic circulation of surveys seems to be an increasing burden on University lecturers. For instance, during the fieldwork in Turkey, one of the interviewees commented that “I receive a lot of questionnaire surveys, but by coming here in person, you gained priority. To be honest, if you had just sent me a survey, it would be ignored”.

The staff interviews were designed to take about an hour, but in two cases in practice took ninety minutes. Participants were reminded at the start about confidentiality and their right to withdraw at any stage. A consent from was also read and signed before beginning. The interviews had issues related to teaching and learning at their heart but formally the schedule itself was consisting of four parts (see Appendix 1). The first part was about the GIS provision and the lecturer’s background and areas of teaching and research specialisation. The second asked briefly for information about the history and development of GIS within the department, and the third focussed most importantly on issues relating to teaching and learning. The final part asked questions about teaching and employability.

Care was taken to word the questions so as to reduce the risk of bias or ambiguity and to avoid phrases which could lead the participants in a particular direction. In designing the staff interview schedule and in planning its conduct, useful general guidance was obtained from a number of key texts such as Arksey and Knight (1999) and Kvale and Brinkmann (2009). In line with the advice of van Teijlingen and Hundley (2001), a pilot interview was conducted to test the effectiveness of the questions asked and to give me helpful interview practice. For convenience reason this took place with a GIS lecturer at Plymouth University. It resulted in some minor textual amendments but no major changes.

In practice the staff interviews worked well and produced valuable information and ideas. They produced rich data and gave me insights into the working life of GIS staff (especially useful to me because when I return to Turkey this will be my job and career). However, I did experience some problems of language. My English was occasionally not good enough to understand everything that was said and there were a few times when listening again to the recordings did not help. It would have been better if the interviews had taken place near the end of my four-year PhD grant period (when my English had improved) but obviously this was not possible because time was needed for analysis and for actually writing the thesis – a sometimes slow and rather difficult task in a second language.

4.5.2 The student questionnaires

Questionnaires are the single most widely used tool for research in the social sciences (Brewerton and Millward 2006) because of their versatility and ability to collect large amounts of data efficiently and in a format which is easy to use. A total of 175 Geography undergraduates, 10 GIS undergraduates and 28 Masters student questionnaires were collected from the UK CSDs. These were normally administered and completed during a GIS teaching session, with the lecturer making available the 10-15 minutes needed and my being present in case there were any questions or problems. Ideally, it would have been helpful, in addition, to have interviews or focus groups with the students but making these arrangements was difficult, because I did not want to cause too much work for the host departments (my philosophy, as explained in section 4.3.2 was deliberately ‘light touch’). Moreover, a questionnaire method meant that data was obtained from much larger numbers of students which in the case of the Geography students allowed for some quantitative analysis. The questionnaires were completed during the last two weeks of the module/course so that by then the students had experienced most of the GIS teaching.

The questionnaire had two slightly different types for Geography undergraduates and for full GIS students (Masters and undergraduates) (Appendices 2, 3 and 4). Essentially, however, the questionnaires were very similar. They included, for example, a brief demographic section about students' backgrounds, gender etc. A second and most important part focussed strongly on the teaching and learning itself. A third part focussed mainly on the teaching and learning of GIS skills: this was informed by literature such as the Body of Knowledge (Diabiase et al. 2006), a SPLINT working paper (LeGates and Kingston 2008), the report of DOLETA (the US Employment and Training Centre) (DOLETA 2010) and papers such as those by Gaudet et al. (2003) and Merry et al. (2007). The third part also asked the students about transferable skills (Gedye and Chalkley 2006, Haigh and Kilmartin 1999) and so linked to the employability agenda which features in the last part of the questionnaire.

The design of the questionnaire was guided by the principles of good practice contained in key texts by authors such as Cohen et al. (2007), Dörnyei and Taguchi (2010) and Oppenheim (2000). Two key messages were the importance of following closely the research aims, and having a clear and attractive layout. The focus on the research aims is illustrated, for example, in the Geography undergraduate questionnaire (Appendix 2) by section 2 on GIS teaching and learning experiences, by section 3 on the students' GIS skills development and by section 4 which included questions related to employability and to students' evaluations of their GIS undergraduate experience. All these areas were central to the purposes of my research and are covered strongly and directly in the questionnaire. The clarity of the questionnaire layout was enchanced by its division into sections and by the use of colours, tables and bold text. The use of tables requiring only ticked-box answers also enabled a lot of information to be gathered in a short time period, namely the ten to 15 minutes reserved at the start of teaching session. As recommended and discussed by many authors (including Cohen et al. 2011, Khan et al. 2008 and Grant et al. 2009, Cox et al. 2011) a Likert-type scale was used to gather information, for example, on the frequency of use of teaching methods (section 2) and on students' assessment of their competence in certain GIS skills (section 3).

However, the questionnaires were by no means confined to tables and deliberately included a mix of both closed and open-ended questions. This illustration of good practice is especially recommended by Hannan (2007 p.3) who argues that "a combination of closed-ended and open-ended questions has advantages in that it preserves the possibility of easy computation whilst providing respondents with the space to develop their own ideas". For example, in section 4 of the Masters questionnaire (see Appendix 4) a Likert scale was used to indicate how far assessment exercises helped the students' learning and then they were asked to explain in their own words their answers.

This mixed approach enabled the open-ended questions to be used for the more qualitative and discursive aspects, while closed, more factual, questions and tables provided opportunities for statistical analysis. The quantitative dimension was also assisted by having an opening section on "Demographic Information". Oppenheim 2000) has emphasised the value of obtaining basic information of this kind in order to build up a profile of the kinds of people being studied and also to enable the statistical analysis of the role of personal variables such as gender and year of study. The information obtained in this section enabled the testing of hypotheses relating to the relationship between students' satisfaction levels and gender and year of study.

Another item of acknowledged good practice adopted in designing the questionnaire was the use of a pilot. As argued by de Vaus (2002, p.114) "when a questionnaire has been developed, each question and the questionnaire as a whole must be evaluated rigorously before final administration". Hoggart et al. (2002), van Teijlingen and Hundley (2001) and White (1988) are also amongst those who have stressed the value of a pilot in testing question wording and whether any key issues are missing. Fink and Kosecoff (1998) emphasized that if possible the pilot group should be similar to or the same as the final target group. In the UK the questionnaire was tested on 32 Geography GIS students at Plymouth University and on 60 Geography GIS students at Canakkale Onsekiz Mart University in Turkey. The pilot outcomes were encouraging but highlighted the need to shorten the questionnaire. As a result it was decide to take out a number of questions on educational resources and materials, this being considered the least essential for inclusion.

The final response levels for the Turkey CSDs are shown later in Section 4.7 but the UK figures are presented immediately below. The proportion of respondents averages close to 50 percent in all three categories (Geography undergraduate, GIS undergraduate and GIS Masters). This figure is based on the proportion of the total numbers enrolled on the module and not on those actually present on the day the survey was administered. Almost all the students who were present completed the survey. It is obviously impossible to judge with any certainty whether the absent students would have given very different answers to those who were there. It could perhaps be suggested that the missing students were absent because at least some of them were not enjoying the course and that their answers might have been more critical: however, there is no evidence to confirm this. What can be said with certainty is that the 50% response rate is higher than that commonly achieved in questionnaire surveys, particularly those done by post or e-mail (Sheehan 2001). Certainly the total student numbers in the Geography category (175) is very encouraging and in the Masters category (28) is reasonable. The low number (10) in the GIS undergraduate category needs to be acknowledged when discussing this category – it reflects reducing recruitments to the programme.

Table 4.2: Questionnaires completed in CSDs * (Geography UG programme)

CSDs			Questionnaires received	Response rate (%)
CSD1	BA	2nd year	42	42
		3rd year	23	41
	BSc	2nd year	0	0±
		3rd year	7	58
CSD2	BA/BSc	3rd year	13	32.5
CSD3	BA/BSc	2nd year	35	35
		3rd year	17	85
CSD5	BA/BSc	2nd year	0	0±
		3rd year	8	33
CSD6	BA/BSc	2nd year	30	64
		Total	**175**	**49**

* This response rate has been calculated with reference to the total number of students enrolled on the module (not the numbers in attendance on the day the survey was administrated).

± There is no questionnaire returned from these classes because the lecturers (the survey "gate-keepers") were reluctant to find time for the survey to be conducted.

Table 4.3: Questionnaires completed in CSDs (MSc and UG GIS)

CSDs		Questionnaire received	Response rate (%)
CSD1	MSc	3	20
CSD2	MSc	23	77
CSD5	MSc	2	50
CSD4	UG GIS	10	55.5
Total		**38**	**51**

*The response rate has been calculated with reference to the total number of enrolled students (not the numbers in attendance on the day the survey was administered).

4.5.3 The classroom observations

The staff interviews and above all the student questionnaire survey (discussed above) were the principal sources of information on pedagogical patterns and teaching issues in the CSDs. However, if we are to understand GIS teaching and learning, it is also obviously useful to see it at first hand. For this reason, "non-participant classroom observation" (Cotton et al. 2010, Simpson and Tuson 2003) was employed. At no time did the author contribute to teaching or participate in any of the activities or discussions. My role was entirely passive. In this way I hoped to observe the teaching without changing it by my presence. The approach was 'naturalistic'.

The purpose of having observations was to learn more about the nature of the GIS teaching and the students' learning experience. It could, for example, shed light on whether the teaching styles were teacher-centred or student centred and whether the students' role was mainly active or passive. Observation was also an additional source of evidence which would make possible some triangulation across other sources. Was there, for example, an important difference between what is said about teaching in the module handbook and what happens in practice?

Although these possible benefits from classroom observations seemed attractive, in practice there were some important limitations and constraints. Despite making clear that my plan was simply to collect information and ideas, I believed that some staff were a little reluctant to be observed because they felt at risk of being evaluated-and evaluated by someone with much less experience of teaching than they had. For this reason my natural interest in quality issues had to be strictly limited by the need to conduct my research in ways which were acceptable to my hosts. Having observed a lot of GIS teaching at Plymouth as a demonstrator, I expected this 'pilot' to help me in the CSDs but these more formal observations of staff I did not know felt very different.

Partly also because of timing problems, I only observed 8 classes, 5 of which were practicals, and 3 were lecture-based theory sessions. All were at undergraduate level. I was not able to observe any teaching at Masters level. However, the observation of staff who taught at both levels gave some clues about their teaching in Masters programmes. No pro-forma was used because of my fear that the academics would be worried about what I was writing about them. The research philosophy of 'light touch' meant that the observations were used with caution. They were interesting and provided some helpful impressions but played only a rather limited role in my research: the staff interviews and above all the student questionnaires proved to be more important sources.

4.5.4 The analysis of pedagogic data

The pedagogy part of this research used information from three different primary data collection techniques (interviews, questionnaires and classroom observations) and also from secondary sources (module handbooks and hands-outs). This section now outlines the ways in which both the qualitative and quantitative data were analysed. Miles and Huberman (1998) described the data analysis process in qualitative studies as "resembling those of quantitative studies" in that the main analysis process is essentially what they refer to as "data reduction" (p.12). This means simplifying the mass of information obtained in order to focus on the key messages, pattern and findings.

With respect to qualitative evidence, use was made of Cresswell's (2009) framework for qualitative interview analysis which consists of a series of steps including reading through the material (familiarisation), coding (organising into themes or segments), narrative preparation (identifying ideas for discussion) and finally drawing conclusions. This ensured a systematic approach, the central part being the coding which gathered material by topic or label (Richards 2009). In the case of the interview recordings all the transcribed text was transferred into the software, Nvivo 9.2 using the main themes of provision, teaching and learning and employability. The “substantive statements” (Gillham 2000, p.71) have been coded under sub-headings such as Continuing Professional Development (CPD) and problems faced, and then discussions and patterns have been generated. Basically, a similar categorization process was used for the open-ended questions in the student questionnaire.

On three occasions (Q4d, Q4j-a and Q4j-b), the word cloud technique was adopted in order to illustrate the prevailing issues visually (Deakin et al. 2012, Fouberg 2012, Wakefield and France 2010). The approach can also be defined as “a content analysis” because the technique works on the basis of counting familiar or identical words. In this PhD study, the Wordle[9] online tool (provided by wordle.net) was used to generate results, because this tool had two advantages: one was that the tool automatically eliminated common daily-usage words (e.g. I, you, and it), and the second was that the visualisation was much better and attractive. However, there was a drawback in that it is case sensitive and does not aggregate similar words and so sometimes words needed to be modified in advance by changing the capital letter and presenting plural and singular words as the same.

Having provided an account of how the qualitative data was analysed, this research also produced some quantitative results thanks to the student questionnaire. The data generated was mainly “categorical”, although occasionally data derived from the Likert-scale could be treated as “ordinal data” (Büyüköztürk 2002). In the analysis

[9] please visit www.wordle.net

process, having entered all the data into spread sheets in the computer, the data analysis performed was mainly at a descriptive level (mean, frequency analysis, cross-tabulations etc.). In addition, in order to achieve a deeper understanding of patterns and relationships within the data, two more advanced statistical tests were used, namely ordinal regression analysis and also Spearman's correlation analysis (Fagin and Wikle 2011, de Vaus 2002). However, it must be emphasised that the ordinal regression analysis required much larger student numbers and so its use confined to Geography undergraduate survey. The regression and Spearman tests were used because respectively they are suitable for data which have ordinal/nominal and nominal/nominal patterns and are commonly deployed statistical tests. Particularly, as suggested by Bradbeer (2004, p.54) "having shown that there are clear patterns of association, you would use correlation and/or regression analysis to measure the degree of association and to test its level of significance". Additionally, ordinal regression analysis was neatly described by Solem et al. (2013) as a technique which "seeks to explore the relationship between a dichotomous-dependent variable and each independent variable while controlling for the other independent variables in the regression equation" (p.98).

In order to determine whether any other statistical tests would be helpful and appropriate, advice was sought from Dr Paul Hewson, a statistics lecturer at Plymouth University who has substantial experience in offering guidance to educational research projects. In my case, Dr Hewson's advice focussed principally on the message that, given the limited number of students surveyed, it would generally not be safe to use tests requiring large data sets or dependent upon assumptions about the nature and characteristics of the survey under analysis. For example, he suggested that although Structural Equation Modelling (SEM) might in principle be helpful it requires a minimum of 400 respondents (Niels J. 2008). Although Dr Hewson therefore warned against the danger of "over-analysis", he did suggest a limited use of ordinal regression analysis. This does not require the data assumptions of the standard form of regression analysis such as having interval and continuous variables with a normal distribution (Yayar et al. 2011, Akin and Senturk 2012). It can importantly be used with Likert scales (4 or five point) which in my research were used to collect data on levels of student satisfaction. This ordinal variable could then be explored for its relationship with independent variables such as gender or year of study. So, given Dr Hewson's advice and that some of my data was by nature ordinal (such as student satisfaction levels), ordinal regression analysis was a useful technique.

In addition some relationships between two variables (such as student satisfaction levels and the extent to which their expectations were met) were also sought by Spearman's correlation analysis (de Vaus 2002 and Haigh 2013).

4.6 The Research on UK GIS and Employability

The key aim of this part of the research was to critically examine the extent to which GIS provision prepares students for working life and particularly for jobs in the GIS field. This clearly required some examination of the GIS sector and the jobs on offer and the skills and knowledge they require.

Drawing on this general aim, the main research objectives of this section include:

- To review the nature and scale of the GIS graduate job market in the UK, and develop a typology of GIS-related graduate jobs.
- To determine the GIS skills needs and requirements of organizations which employ GIS staff.

- To assess the extent to which the current provision and practice of GIS training and education meets the requirements of the GIS graduate job market.

Although some very useful information on employability came from the CSD handbooks, the staff interviews and the student questionnaires, this part of the PhD research clearly needed at least some contact with employers and an examination of GIS jobs. Using advice from members of the RGS-IBG GIScience Research Group some names were suggested of possible UK organisations to approach. These were divided into four sub-sections: Software Product Vendors, Data Providers, Service Providers and Hardware Vendors. Eight organisations (two from each category) were sent an invitation letter but despite follow-up letters and telephone calls the response was a little disappointing with staff often too busy to agree to an interview. In the end there were two interviews (one face to face and one by phone) with a further three participants returning a completed survey form which was identical to the interview schedule. More positively, all the respondents were involved at a senior level in the staff recruitment process and clearly had a good wider knowledge of the GIS job market. Of the five responding organisations, four were in the private sector and one in the public sector.

The second piece of extra research beyond the academic CSDs was a review of GIS job adverts. The researcher's own experience and a detailed internet search showed that there were two main specialist online GIS job agencies (which are www.GIS-jobs.co.uk and GIS-jobs@jiscmail.ac.uk which is a JISC e-mail list working independently for jobs' seekers in the UK). In addition, it was also recognized that there could be some jobs mainly advertised as a Geography-related jobs, but which might include some GIS skills. So, in addition to these two specialist GIS agencies, one more online job agency chiefly focussed on Geography graduates was also reviewed (www.geographyjobs.co.uk).

It took quite a lot of time across a twelve month period to monitor the sites, collect the information and to identify the main findings. All the advertised jobs and the supporting details were read immediately and then at the end all were re-read and collated under a typology to help identify the main patterns. As an independent subscriber to the web-sites, I managed the job adverts (over 300) within my e-mail account by creating a special folder. The jobs classification process was inevitable a little arbitrary but, as shown in chapter eight some interesting patterns were found.

It is worth making one extra point on employability. Early in the research process, the idea was considered of making a study of former GIS students who are now in the GIS workplace. This would be good at finding out whether students felt their GIS education had prepared them for GIS jobs. However, it was soon clear that this kind of study was not really possible. There were confidentiality problems in Universities providing names and addresses of former students and doubts about whether jobs and addresses would be up to date. Although the recent paper by Whytte et al. (2011) showed that this approach could sometimes work (but with only a 26% response rate) it was decided that there would not be time to do this kind of study, especially in both the UK and Turkey.

4.7 The Turkish Research

This section outlines the research methods used in Turkey. As far as possible, these were the same as in the UK (including, of course, questionnaires and ethics protocols). This made comparisons more valid. Given the high level of similarity, this present section is quite brief, giving most attention to points of difference. It is true, however, that the Turkish study was rather smaller in size, and it was always planned that the UK should be the main focus of the thesis. Time and financial constraints on the Turkish fieldwork was another factor. Three months were spent in Turkey collecting the data.

4.7.1 Selecting and working with the Turkish case study departments (TRCSDs)

Four CSDs in Turkey were chosen compared with six in the UK. In Turkey, there are 22 Universities which offer geography degrees (almost all of which have some GIS), but there are only two Geography-based Masters programmes and there are no undergraduate GIS degrees at all. In this way the selection process was more straightforward and did not need the kind of typology review undertaken in the UK.

Amongst the Geography degrees, it was considered important to ensure a balance between old and newer institutions. By coincidence, like the UK, Turkish Higher Education went through a major re-organisation in 1992 and so it was decided to choose two pre-1992 and two post-1992 Universities. The particular Universities chosen were picked partly also for reasons of cost and convenience. Turkey is a large territory and HECoT, the research sponsor, offered limited funds with travel by bus only. In selecting the CSDs, including the Masters programme, an important factor was that all the Universities should be reasonably close to each other. In one case also I had an existing contact which helped. No institution approached refused to co-operate. Working with the Turkish departments was basically similar to the UK, with a ‘light touch’ approach and an emphasis on requiring goodwill and support for the research. There were no reasons for believing that the TRCSDs were atypical in terms of their size, status or curriculum.

4.7.2 The research on GIS provision in Turkey

Information on the number and distribution of Universities offering undergraduate Geography degrees was collated through the Student Selection and Placement Centre (OSYM[10]) which publishes a booklet each year which shows for each subject the departments which are going to recruit students and how many. This was followed by a web-based approach to collecting information on Geography curricula and whether there were modules on GIS.

With respect to the detailed content of the GIS curriculum, at both Masters and undergraduate level, this was more difficult than in the UK, because it is not the custom in Turkey to publish detailed documents such as module handbooks and programme specifications. I had to depend more on conversations with the relevant staff. There were documents relating to the European Credit Transfer System (ECTS) but these said very little about the curriculum or about teaching and learning. The limited nature of the documentary evidence available may reflect that quality assurance procedures are so far less well developed in Turkey than in the UK.

4.7.3 The research on GIS pedagogy in Turkey

As in the UK, the main sources used were the semi-structured interviews with staff and the student questionnaire survey. There were five staff interviews, including the programme co-ordinator for the Master course. These were in total 137 Geography undergraduate questionnaires completed (see Table 4.4). On average the proportion of enrolled students who replied was 75 percent (see Table 4.4). The Masters course only had 8 students all of whom replied. I was able to observe a total of 6 teaching sessions: 4 were practicals and 2 were theory lectures.

[10] Please visit www.osym.gov.tr for further information

Table 4.4: Questionnaires completed in the TRCSDs* (Geography UG and MSc programmes)

CSDs			Questionnaires Received	Response Rate (%)
TRCSD1	BA/BSc	2nd year	27	60
		3rd year	14	78
		4th year	3	10
TRCSD2	BA/BSc	2nd year	19	95
		3rd year	9	90
	MSc	-	8	100
TRCSD3	BA/BSc	2nd year	22	88
TRCSD4	BA/BSc	2nd year	43	78
Total			**145**	**75**

* This response rate has been calculated with reference to the total number of students enrolled on the module (not the numbers in attendance on the day the survey was administrated).

The interviews were obviously conducted in Turkish which was for me much easier. The student questionnaire was translated from the English originals and the data analysis process was the same. It was interesting, however, that the Turkish students were less willing to add comments or to give more than very basic answers to the open-ended questions. Boxes for extra comments or explanations were more often empty. This might be related to a cultural behaviour because there is no student evaluation system in Turkey and students are less familiar with giving their views.

4.7.4 The research on GIS and employability in Turkey

As in the UK, there is no simple way of having a list of organisations who employ GIS staff, and so I obtained advice from GIS colleagues about the kinds of organisations which should be approached about GIS jobs and employability. It is important that there is in Turkey no major civic data provider like the Ordnance Survey in the UK. There is a 'General Command of Mapping' but they produce a more limited range of digital and hard-copy survey maps, so that many organisations need to produce their own data and services.

I was able to obtain information on employment patterns and employability requirements from four organisations. They covered a variety of areas such as software vendors and consultancy. All the private organisations approached gave me an interview (unlike the UK) with one or more staff members who were familiar with GIS posts and appointments. However, no governmental organisations were included: the ‘General Command of Mapping’ was not approached because they were unlikely to offer an interview and because they appoint the GIS staff mainly from the military. So, a total of eight people were interviewed (typically for about an hour) from four GIS companies. In addition, two recruitment websites were used for a year to create a data-base of job advertisements related to GIS and Geography. Details from 127 posts were collated in this way in order to gain an understanding of the kinds of jobs available and the skills expected. The job web-sites were: kariyer.net and SecretCV.com.

4.8 Synopsis

This chapter has provided a detailed account of how this research undertaken within two different countries and using two different languages. In the data collection process, the fieldwork visits to six case study departments in the UK and to four case study departments in Turkey were completed. In the context of these visits, several research activities were undertaken, including interviewing lecturers, surveying students, making classroom teaching observations and collecting relevant documents. This variety of data sources was designed to assist with triangulation to allow the researcher to cross-check the main assertions and findings. Above all, it enabled the thesis to address more fully its aims and to explore its main research questions, especially related to provision and pedagogy.

With respect to employability, in addition to the information obtained from case study departments, contact was made with a number of GIS employers in order to consider the extent to which graduates with GIS training actually meet the needs of employers. Also, a database including job advertisements which covered a period of 12 months has been created using data available at recruitment web-sites advertising jobs related to GIS and Geography. This process was undertaken for both the UK and Turkey.

Overall, in the UK, primary data sources consisting of 11 Interviews with GIS lecturers, 185 UG student questionnaires and 28 Masters student questionnaires have been collected from the case study departments. In Turkey, 5 interviews with GIS lecturers, 137 UG student questionnaires and 8 Masters student questionnaires were completed. For employability data, interviewing 14 individuals at managerial level has been achieved (6 for the UK and 8 Turkey).

The research programme has therefore collated a large amount of data from a variety of different sources and from two different countries. Although much of the data comes from ten departments, this represents a substantial body of original research and a good basis for analysis and interpretation. So, the thesis now moves forward to the discussion of results and findings, first from the UK and later from Turkey.

CHAPTER 5 : GIS PROVISION IN THE UK

5.1 Introduction

This chapter provides an account of GIS provision based in Geography departments (or sections/units) in UK Higher Education (HE). It is divided into two main parts: a broad overview of GIS provision across UK Geography departments nationwide and a more detailed analysis of GIS provision in six Case Study Departments (CSDs). The start of each section describes the questions it examines in relation to the wider aims of the thesis.

5.2 A Review of GIS Provision within Geography Departments

This section gives an overview of GIS provision in UK Geography Departments and addressed the following questions:

- How much GIS is offered where and in which kinds of institutions?
- How can the provision be classified into different types or categories?
- How many GIS modules are offered within each Geography degree programme and at what level?

As explained in chapter four, the web site of the Royal Geographical Society with the Institute for British Geographers (RGS/IBG) was used to identify those HEIs providing degree level education in Geography and/or GIS. Some 87 providers were listed offering a range of courses at undergraduate or postgraduate level (RGS-IBG 2009). In addition to BA/BSc Geography programmes, there were courses in areas such as Human Geography, Physical Geography, Geography and Environmental Studies and GIS itself. However, cross-referencing the RGS list against institutional websites and by making direct enquires with individual HEIs, the RGS/IBG starting figure of 87 was reduced to 70. Seventeen HEIs were no longer offering a Geography degree (or variant programmes). Of these 17, three were nonetheless providing in GIS courses (undergraduate or Masters) but they were not organizationally coming from a geography background and instead had their roots elsewhere, principally in Engineering. Given the Geography focus of this PhD study, they were therefore not included in the typology work detailed in section 5.2.4.

In order to identify the presence or absence of GIS modules within Geography or related degrees, it was necessary to check departmental web-pages and occasionally to follow up with e-mail or telephone enquiries. Analysis of the data collected has shown that GIS modules have become embedded in a wide variety of Geography programmes and at different levels or stages. In essence, there are three main types of GIS provision. These are: 1) GIS named undergraduate degrees; 2) GIS named Masters degrees; and 3) GIS modules being delivered within Geography undergraduate (GU) degree programmes. This third category can be divided according to the number of GIS modules provided.

There are two other types of Geography-based GIS provision, which are not included within the scope of this PhD survey. The first is GIS modules delivered by Geography department staff for Masters programmes in other disciplines such as Business studies and Sustainable Development. Although preliminary enquiries made it clear that these are rare, there are a very large number of Masters courses within the UK, and investigating these comprehensively was ruled out on the grounds of the time commitment involved. The small number of distance learning GIS Masters courses are also considered beyond the scope of this thesis. These were eliminated not only for reasons of time but also because of the special difficulties of contacting students, observing teaching and evaluating this kind of student experience (Aksal et al. 2008). Additionally, a small number of distance learning courses can also cause to damaging the anonymity of the CSDs.

5.2.1 Provision of GIS within BA/BSc Geography degree programmes

The integration of GIS into Geography degree curricula has been widely established. More detailed information about what is offered in each HEI is discussed in the typology section of this chapter (section 5.2.4). As indicated above, the modules being delivered at undergraduate level can be divided into two categories: those where the programme has more than one module (31 departments) and those where the programme has only one GIS module (29 departments). When considering the history of institutions, 55 percent of institutions in the first category and 69 percent of institutions in the second category are pre-1992 universities. Therefore, most of this kind of GIS provision (a little over 60 percent) is in 'old' universities, this is very similar to the balance of Geography departments as a whole (63 percent of which in pre-1992 HEIs).

Although there can be a small number of GIS sessions taught at first year level (often as part of skills or technique modules), the GIS modules themselves typically are found at stages 2 and/or 3. However, there are a small number of departments with a GIS named module at stage 1. As an example, Canterbury Christ Church University has a basic GIS module called Introduction to GIS in the first year, after stage 1, it then offers a module entitled GIS (advanced). In total there are ten HEIs which offer named GIS modules in all three years of the programme. In these cases it is common for the 3rd year module to have a particular subject emphasis such as GIS in environmental management or planning.

Almost half of the Geography departments offer only a single GIS named module in their programme, although, as indicated above, there can be a small amount of “hidden” GIS teaching elsewhere. Another important issue to be considered is the situation of the ten Geography undergraduate courses that do not appear to offer any named GIS modules in their programmes. There may of course be a small amount of GIS concealed under the another title but no attempt has been made to quantify this kind of “hidden” GIS teaching, as it would require reading through some hundreds of module documents which are generally not in the public domain.

5.2.2 Provision of GIS undergraduate degree programmes

As shown in Table 5.1, the survey found seven Geography-based undergraduate degrees focussed exclusively or largely on GIS. There were only five undergraduate Geography-based programmes with GIS as their sole focus, with another two institutions offering a combined programme in Geography and GIS. The majority of GIS undergraduate degrees are in the post-1992 sector. However, as shown below the reverse is the situation at Masters level. This may reflect the older universities' generally stronger engagement with postgraduate teaching and research.

Table 5.1: Geography-based GIS undergraduate degree programmes across the UK[11] (2009)

The name of University	The name of degree programmes
Bath Spa University College (Post-1992)	GIS
University of Glamorgan (Post-1992)	Geography and GIS
University of Glasgow (Pre-1992)	Geoinformatics
Kingston University (Post-1992)	GIS
Manchester Metropolitan University (Post-1992)	Geography with GIS
University of Portsmouth (Post-1992)	GIScience
University of Wales, Swansea (Pre-1992)	Geo-informatics

[11] In addition to seven Geography-based Undergraduate GIS programmes, the author's searches identified three programmes based in Engineering.

5.2.3 Provision of GIS Masters degree programmes

In contrast to the rather limited provision of GIS undergraduate degrees, the survey revealed a substantially larger number of GIS Masters degrees. As shown in Table 5.2, the total figure for Masters programmes (MSc and MA) was twenty-two, of which 15 were in pre-1992 universities. It should also be emphasised that all but one of them are entirely Geography-based Masters programmes. But the list includes one course which is organized jointly through Geography and Engineering. While the programmes were mainly called MSc in GIS or in GIScience, a small number were combined Masters degrees. Partner subjects included, for example, Human Geography with GIS, Social and Cultural Geography and Human Geography with GIS, GIS for Business Consultancy (the University of Leeds) and GIS and Remote Sensing (University of Cambridge, University College London). Interestingly, a Masters programme entitled Geo-Information for Environmental Modelling and Management offered by the University of Southampton, is part of a consortium including three other EU universities under the auspices of the EU Erasmus Mondus programme. As indicated earlier, there are more Masters programmes than undergraduate GIS degrees. The reasons for this may relate to GIS being seen as (arguably) rather too narrow and specialized for a full undergraduate programme. Moreover, Masters courses in many fields have a stronger professional and vocational emphasis which is more appropriate for GIS.

Table 5.2: The provision of Geography-based GIS Masters degree programmes in the UK (2009)

The name of University	The kind of course	The name of course
University of Aberdeen (Pre-1992)	MSc	Geospatial Information Systems
Aberystwyth University(Pre-1992)	MSc	Geographical Information Systems (GIS) and Remote Sensing
Birkbeck College (Pre-1992)	MSc/PG Dip/PGCert	Spatial Information Science Geographic Information Science (GISc) Geographic Information Science (GISc) Part-time Evening Taught
University of Brighton (Post-1992)	MSc	GIS and Environmental management
University of Cambridge (Pre-1992)	M.Phil	Geographical Information Systems and Remote Sensing
Coventry University (Post-1992)	MSc	Environmental Hazards and Geographical Information Systems
University of Edinburgh (Pre-1992)	MSc MA	Geographical Information Science (GIS) Geographical Information Science by research Geographical Information Science & Society
University of Glamorgan (Post-1992)	MSc	Conservation and GIS
University of Glasgow (Pre-1992)	MSc	Geoinformation Technology and Cartography Geospatial & Mapping Sciences
University of Greenwich (Post-1992)	MSc/PGDip	Geographical Information Systems with Remote SensingRemote Sensing with Geographical Information Systems
Keele University (Pre-1992)	MSc	Spatial Patterning of Social and Community Provision
Kingston University (Post-1992)	MSc	GIS Applied Geographical Information Systems Geographical Information Systems and Science
University of Leeds (Pre-1992)	MA MSc	Human Geography with GIS Social and Cultural Geography and Human Geography with GIS GIS for Business Consultancy Geographical Information Systems (GIS)
University of Leicester (Pre-1992)	MSc/ PG Dip	GIS GIS & Human Geography (ESRC accredited)
University of Manchester (Pre-1992)	MSc	Geographical Information Science
Manchester Metropolitan University (Post-1992)	MSc	GIS and Spatial Analysis
University of Nottingham (Pre-1992)	MSc	GIS Geospatial Intelligence
University of Portsmouth (Post-1992)	MSc	GIS
University of Salford (Pre-1992)	MSc/PG Dip/PG Cert	Geographical Information Systems Applied Geographical Information Systems and Remote Sensing
University of Southampton (Pre-1992)	MSc	Remote Sensing and Spatial Analysis Geo-information Science for Environmental Modelling and Management
University of Ulster at Coleraine (Pre-1992)	MSc/PG Dip/PG Cert	Geographic Information Systems (GIS)
University College of London*	MSc	GIScience Remote Sensing

*This programme is offered in collaboration with other programmes within the same university (e.g. Engineering Department) with other universities within the same city (e.g. Birkbeck College)

Provision of GIS named distance learning programmes

Although, as explained earlier, no detailed survey work has been undertaken on GIS distance learning, the reader may welcome some basic understanding of its size and significance. In total, the survey revealed seven Geography-based GIS distance learning programmes. Three of these were at Masters level: an MSc in GIScience (Birkbeck College), an MSc in GISystems (University of Southampton) and a postgraduate course offered by a consortium called UniGIS, in association with a number of universities including Manchester Metropolitan University and the University of Salford. The survey found a range of UniGIS-accredited GIS post-graduate programmes on offer to students wanting to take online education. This is an international network which works with a number of universities from different countries. Their main aim is to deliver online GIS Masters courses or certificate programmes with the collaboration of the home country's universities. These are completely based on distance learning methods (for further information see www.unigis.co.uk). The other four were certificate or professional training programmes: these were offered in both conventional and distance learning modes. An example is the University of Chester's on-line training programme called 'Top-Up 4 Teaching: Geography' designed to improve the GIS skills of 'A-level' Geography teachers. Kingston University, Edinburgh University and Leeds University offer a GIS professional training programme to persons who wish to improve their GIS software skills (Table 5.3).

Table 5.3: Geography-based GIS Distance Learning programmes in the UK (2009)

University	Type of programme	Name of programme
Birkbeck College (Pre-1992)	MSc / PG Dip / PG Cert	GIScience
University College Chester (Post-1992)	Certificate	Top-Up 4 Teaching: Geography
University of Edinburgh (Pre-1992)	Training	Personel Training Programme in GIS
Kingston University (Post-1992)	Certificate	GIS professional training
University of Leeds (Pre-1992)	Short courses	GIS courses
University of Southampton (Pre-1992)	MSc	GISystems Geo-Information for Environmental Modelling and Management
University of Salford (Pre-1992) and Manchester Metropolitan University (Post-1992)	MSc/ PG Dip / PG Cert	Geographical Information Systems

As underlined in Table 5.3, the HEIs offering distance learning GIS include both pre- and post-1992 Universities. Similarly, although no undergraduate GIS provision is offered in this way, there is an online mix of Masters, short professional courses and certificates.

5.2.4 A typology of GIS provision in the UK

As indicated above, the survey found that the vast majority of Geography degrees have at least one GIS module at undergraduate level and also there are a smaller number of Geography-based GIS Masters, Bachelor programmes and Distance Learning courses. These four categories form the basis for the detailed institutional information presented in Table 5.4, with the Geography undergraduate programmes being further sub-divided according to the number of GIS modules offered.

Some universities such as Kingston, Birkbeck College, Edinburgh, Portsmouth, and Bath Spa are represented in more than one category. Based on a kind of filter analysis, potentially there could be 24 different types of institution as shown in Figure 5.1. This analysis is also known as a ‘decision tree’. It must be emphasised, however, that there is no implication that the provision labelled ‘type 1’ is inherently stronger or superior to the others. Although it provides an interesting framework, the filter analysis is simply a device for classification. The type numbers reflect the design of the hierarchy which was intended to identify categories (not gradings). Interestingly, only 12 out of the 24 possible types are in fact represented by the UK provision (Table 5.5). For instance, type 1 is a department which has a GIS named Bachelor degree, a Masters degree, a distance learning programme, and more than one GIS module in its undergraduate programme. Two post-1992 universities, namely Manchester Metropolitan University and Kingston University comprise type1.

Table 5.5 therefore enables the researcher to bring together departments which have the same basic GIS features. This approach also gives an opportunity to see the institution's breadth of GIS provision, because the type number also indicates the breadth of what is offered. Universities with low numbers (e.g. type 1, 4 and 5) have a more varied GIS provision than the others. This would seem to suggest that these universities put more emphasis on teaching GIS, although it must be re-emphasised that the table makes no claim to rank quality, expertise or reputation. For example, Edinburgh University, which offered the first post-graduate programme in the UK and Europe, and some other long-standing institutions in GIS Education, appear in mid-table as type 13 (Table 5.5).

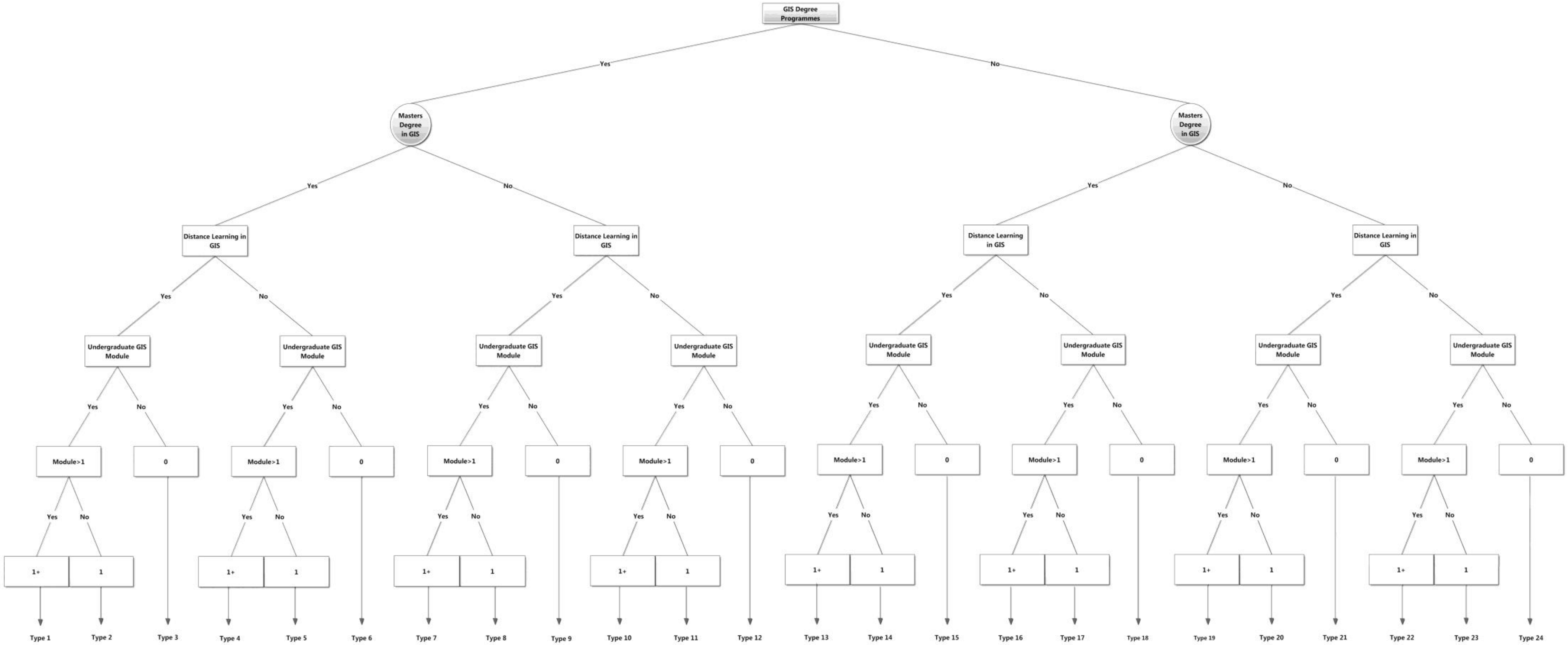
Table 5.4: The typology of GIS provision within Geography departments across the UK

Universities with a GIS UG programme	Universities with a Masters programme in GIS	Universities with a GIS distance learning programme	The number of GIS Undergraduate modules in Geography UG programmes		
			Universities with only one GIS module in their UG Geography programmes	Universities with more than one GIS module in their UG Geography programmes	Universities with no GIS modules in their UG Geography programmes
Bath Spa University College **(Post-1992)**	University of Aberdeen **(Pre-1992)**	Birkbeck College **(Pre-1992)**	University of Aberdeen **(Pre-1992)**	Canterbury Christ Church University College **(Post-1992)**	University of Central Lancashire **(Pre-1992)**
University of Glamorgan **(Post-1992)**	Aberystwyth University **(Pre-1992)**	University College Chester **(Post-1992)**	Aberystwyth University **(Pre-1992)**	Cardiff University **(Pre-1992)**	King's College London, University of London **(Pre-1992)**
University of Glasgow **(Pre-1992)**	Birkbeck College **(Pre-1992)**	University of Edinburgh **(Pre-1992)**	Bath Spa University College **(Post-1992)**	University College Chester **(Post-1992)**	University of Stirling **(Pre-1992)**
Kingston University **(Post-1992)**	University of Brighton **(Post-1992)**	Kingston University **(Post-1992)**	Birkbeck College **(Pre-1992)**	University of Derby **(Post-1992)**	St Mary's College **(Pre-1992)**
Manchester Metropolitan University **(Post-1992)**	University of Cambridge **(Pre-1992)**	University of Leeds **(Pre-1992)**	University of Birmingham **(Pre-1992)**	University of Dundee **(Pre-1992)**	University of Strathclyde **(Pre-1992)**
University of Portsmouth **(Post-1992)**	Coventry University **(Post-1992)**	University of Southampton **(Pre-1992)**	University of Bradford **(Pre-1992)**	Edge Hill College of Higher Education **(Post-1992)**	University of Wolverhampton **(Post-1992)**
University of Wales, Swansea **(Pre-1992)**	University of Edinburgh **(Pre-1992)**	University of Salford **(Pre-1992)**	University of Brighton **(Post-1992)**	University of Edinburgh **(Pre-1992)**	Open University **(Pre-1992)**
	University of Glamorgan **(Post-1992)**	Manchester Metropolitan University **(Post-1992)**	University of Bristol **(Pre-1992)**	University of Hertfordshire **(Post-1992)**	Liverpool Hope University **(Post-1992)**
	University of Glasgow **(Pre-1992)**		University of Cambridge **(Pre-1992)**	University of Hull **(Pre-1992)**	Royal Holloway, University of London **(Pre-1992)**
	University of Greenwich **(Post-1992)**		University of Durham **(Pre-1992)**	Kingston University **(Post-1992)**	University College Northampton **(Pre-1992)**

	Keele University **(Pre-1992)**		University of Exeter **(Pre-1992)**	Lancaster University **(Pre-1992)**	
	Kingston University **(Post-1992)**		University of Greenwich **(Post-1992)**	University of Leeds **(Pre-1992)**	
	University of Leeds **(Pre-1992)**		University of Glamorgan **(Pre-1992)**	Coventry University **(Post-1992)**	
	University of Leicester **(Pre-1992)**		University of Glasgow **(Pre-1992)**	Leeds Metropolitan University **(Post-1992)**	
	University of Manchester **(Pre-1992)**		University of Gloucestershire **(Post-1992)**	University of Leicester **(Pre-1992)**	
	Manchester Metropolitan University **(Post-1992)**		Keele University **(Pre-1992)**	Liverpool John Moores University **(Post-1992)**	
	University of Nottingham **(Pre-1992)**		University of Liverpool **(Pre-1992)**	Loughborough University **(Pre-1992)**	
	University of Portsmouth **(Post-1992)**		London School of Economics **(Pre-1992)**	University of Manchester **(Pre-1992)**	
	University of Salford **(Pre-1992)**		Nottingham Trent University **(Post-1992)**	Manchester Metropolitan University **(Post-1992)**	
	University of Southampton **(Pre-1992)**		University of Oxford **(Pre-1992)**	University of Newcastle Upon Tyne **(Pre-1992)**	
	University of Ulster at Coleraine **(Pre-1992)**		Oxford Brookes University **(Post-1992)**	University of Northumbria **(Post-1992)**	
	University College London **(Pre-1992)**		University of Plymouth **(Post-1992)**	University of Nottingham **(Pre-1992)**	
			University of St Andrews **(Pre-1992)**	University of Portsmouth **(Post-1992)**	
			University of Salford **(Pre-1992)**	Queen Mary, University of London **(Pre-1992)**	
			University of Sussex **(Pre-1992)**	The Queen's University of Belfast **(Pre-1992)**	
			University of Wales, Swansea **(Pre-1992)**	University of Reading **(Pre-1992)**	
			University of Ulster at Coleraine **(Pre-1992)**	University of Sheffield **(Pre-1992)**	
			University College Worcester College **(Post-1992)**	University of Southampton **(Pre-1992)**	
			University of West of England, Bristol **(Post-1992)**	University of Staffordshire **(Post-1992)**	
				University of Sunderland **(Post-1992)**	
				University College London **(Pre-1992)**	

In this filter analysis, the GIS degree programmes have been used as the dominant factors, because full degree programmes require more technical and academic infrastructure. Therefore, a hierarchical approach has been used which begins with full GIS undergraduate degree programmes and proceeds to GIS Masters and later to undergraduate modules within Geography courses. As referred to earlier in chapter 4 on research methods, this typology was also used to help select the Case Study Departments (CSDs), which were the focus of more intensive and detailed study whose findings are presented later in this chapter but mainly chapters 6-8. The six UK CSDs were all taken from different categories in the typology (precise type numbers are not given in order to protect their anonymity). Finally a map has been prepared (Figure 5.2) which shows the spatial distribution of Geography-based GIS provision in the UK (broken down into categories used in the typology). Given this is a Geography thesis, it was felt that the reader might be interested to see the map. It is principal message is that the spatial distribution of the provision broadly reflects the geography of HEIs and the UK's population as a whole.

Figure 5.1: The filter analysis (decision tree) used in the creation of a mutually-exclusive typology



<u>Keys:</u>

Module≥1: Module number is equal to one or more
1+: More than one GIS module
1: Only one GIS module
0: No GIS module

Table 5.5: A Typology of GIS

Types	Features of GIS Provision						The name of university
	Undergraduate Degree Programmes	Masters Degree Programmes	Distance Learning Programmes	1> UG GIS Modules	One UG GIS Modules	No GIS UG Modules	
1	x	x	x	x			Manchester Metropolitan University (Post-1992) Kingston University(Post-1992)
4	x	x		x			University of Portsmouth(Post-1992)
5	x	x			x		University of Glamorgan (Post-1992) University of Glasgow (Pre-1992)
11	x				x		Bath Spa University College (Post-1992) University of Wales, Swensea (Pre-1992)
13		x	x	x			University of Leeds (Pre-1992) University of Edinburgh (Pre-1992) University of Southampton (Pre-1992)
14		x	x		x		Birkbeck College (Pre-1992) University of Salford (Pre-1992)
16		x		x			University College London (Pre-1992) Coventry University (Post-1992) University of Manchester (Pre-1992) University of Leicester (Pre-1992) University of Nottingham (Pre-1992)
17		x			x		University of Aberdeen (Pre-1992) Aberystwyth University(Pre-1992) University of Brighton (Post-1992) University of Cambridge (Pre-1992) University of Greenwich (Post-1992) Keele University (Pre-1992) University of Ulster at Coleraine (Pre-1992)
19			x	x			University College Chester (Post-1992)
22							Cardiff University (Pre-1992) Canterbury Christ Church University College (Post-1992) University of Derby (Post-1992) University of Dundee (Pre-1992)

Types	Features of GIS Provision						The name of university
	Undergraduate Degree Programmes	Masters Degree Programmes	Distance Learning Programmes	1> UG GIS Modules	One UG GIS Modules	No GIS UG Modules	
22 (cont.)				x			Edge Hill College of Higher Education (Post-1992) University of Hull (Pre-1992) University of Hertfordshire (Post-1992) Lancaster University (Pre-1992) Leeds Metropolitan University (Post-1992) Liverpool John Moores University (Post-1992) Loughborough University (Pre-1992) University of Newcastle Upon Tyne (Pre-1992) University of Northumbria (Post-1992) Queen Mary, University of London (Pre-1992) The Queen's University of Belfast (Pre-1992) University of Reading (Pre-1992) University of Sheffield (Pre-1992) University of Staffordshire (Post-1992) University of Sunderland (Post-1992)
23					x		University College Worcester College (Post-1992) University of Sussex (Pre-1992) University of St Andrews (Pre-1992) University of Plymouth (Post-1992) University of Oxford (Pre-1992) Oxford Brookes University (Post-1992) Nottingham Trent University (Post-1992) London School of Economics (Pre-1992) University of Liverpool (Pre-1992) University of Gloucestershire (Post-1992) University of Exeter (Pre-1992) University of Durham (Pre-1992) University of Bristol (Pre-1992) University of Bradford (Pre-1992) University of Birmingham (Pre-1992) University of West of England (Post-1992)
24						x	University of Central Lancashire (Pre-1992) Liverpool Hope University (Post-1992) Royal Holloway, University of London(Pre-1992) King's College London (Pre-1992) St Mary's College (Post-1992) University of Stirling (Pre-1992) University of Strathclyde (Pre-1992) Open University (Pre-1992) University College Northampton (Pre-1992) University of Wolverhampton (Post-1992)

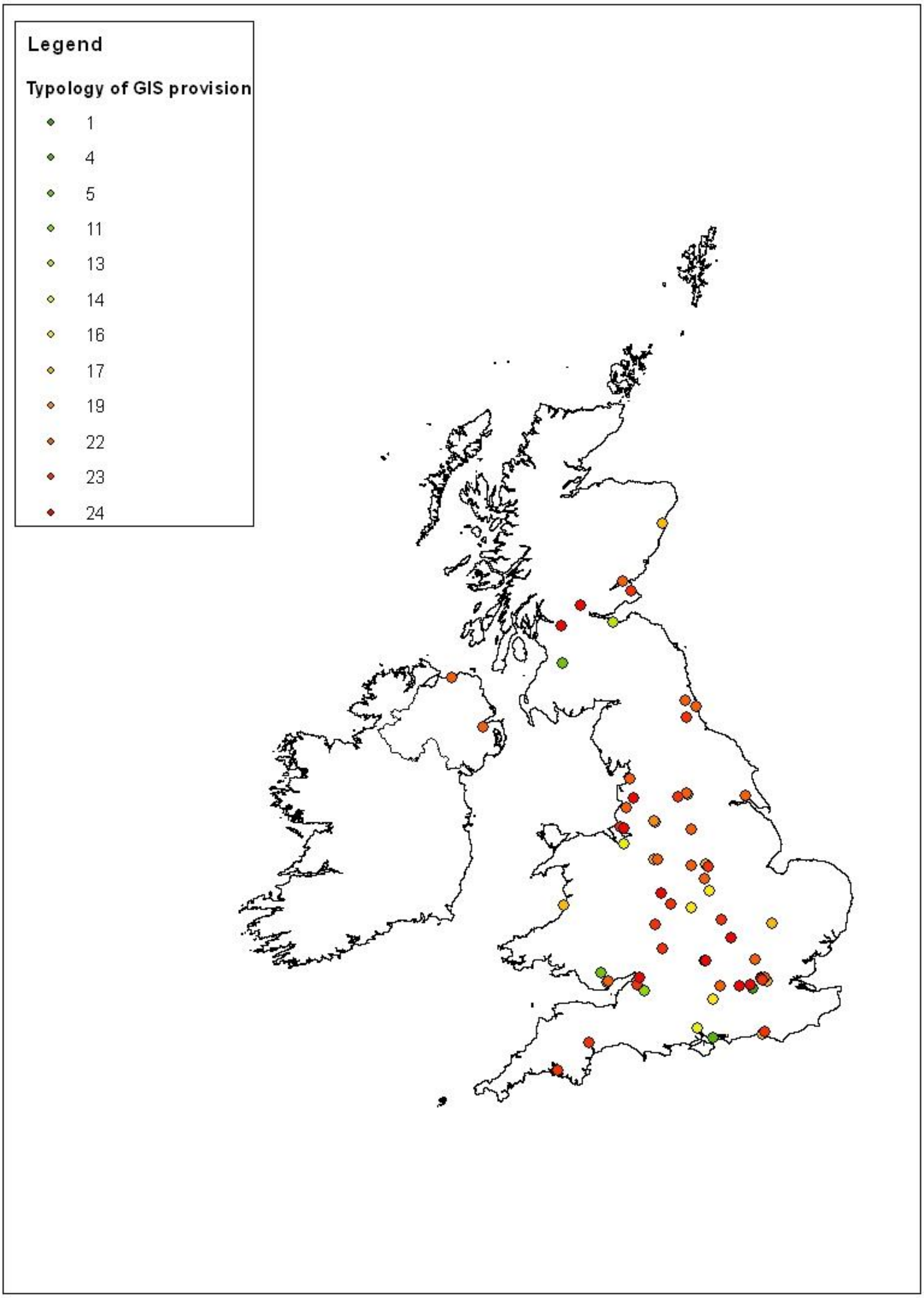


Figure 5.2: Map of typology of Geography-based GIS provision in the UK

5.3 GIS Provision in the Case Study Departments (CSDs)

Section 5.2 has set out the spectrum of Geography's GIS provision in UK Higher Education. This section (5.3) provides a more detailed examination of the provision made in the six Case Study Departments (CSDs) at both undergraduate (UG) and postgraduate level (PG). Of the six CSDs, all offer an UG Geography degree (five of which have designated GIS modules), one has an UG GIS programme and three have GIS MSc programmes. The nature of GIS provision at University level has therefore been investigated using case studies in order to address the following kinds of questions:

- What factors influenced the local emergence and development of GIS provision?
- How many students are recruited to the different types of GIS provision? What are the enrolment patterns?
- Within Geography, what are the main provision features in terms of whether GIS is optional/compulsory, its credit weigthings and how much of students' curriculum it occupies?
- Do the CSD Geography degree programmes have significant amounts of 'hidden' GIS teaching (in modules not bearing a GIS title)?
- Do the GIS modules cover both physical and human geography applications. Is there any relationship between content and the lecturers' research specializations?
- What are the main areas covered by the GIS curricula, how much does this vary between the three main types of provision and how closely does this align with the Body of Knowledge (BoK)?

- What kinds of GIS teaching facilities (e.g. software, laboratories) do Geography Departments typically have to help deliver their GIS curricula?

In order for these research questions to be answered, a diverse set of data has been reviewed and analysed, using both numerical and qualitative approaches. However, much of the information comes from programme/module handbooks and from staff interviews.

This part of the chapter includes four main elements: section 5.3.1 provides a commentary on how GIS education has been developed in the CSDs; 5.3.2 outlines the main characteristics of the GIS provision in the Case Study Departments (CSDs) with a focus principally on UG Geography; 5.3.3 examines the curricula of GIS UG and Masters courses, and 5.3.4 addresses the issues relating to the facilities provided for GIS education in the CSDs.

5.3.1 The development of GIS education in the case study departments

Firstly, focusing on GIS provision in the UG Geography programmes, the early 1990s was a time when Geography departments, particularly in post-1992 universities, first began to put GIS into their undergraduate courses. The vocational emphasis of the Polytechnics may have played a part in this. The staff interviews made clear that the introduction of GIS was often through the work of one or two pioneering enthusiasts who had relevant expertise and were keen to launch teaching in this area. The importance of a key individual is illustrated by the fact that the very first UG GIS module was in a post-1992 institution where a leading figure in digital Cartography was the pioneer.

One of the main factors in developing MA/MSc provision in GIS was the work of the Regional Research laboratories (RRLs) which aimed at encouraging quantitative research methods in the social science disciplines, and included within this the development of GIS education and training (Masser 1988b). Eight Geography departments were chosen to accommodate RRLs in the late 1980s (see section 3.3). As referred to in the earlier part of this chapter, the majority of the MSc provision in GIS programmes became available in the pre-1992 universities and given their strong research records, it was those which hosted the RRLs. Two of the CSDs in the pre-1992 Universities certainly benefited from having hosted RRLs (Unwin 2010). As Flowerdew and Stillwell (2004) have underlined, the RRLs were one of the main drivers which encouraged the host institutions to offer MSc programmes in GIS. Overall, it seems that post-graduate provision became available earlier than undergraduate provision, because GIS was often seen as more specialist, technical, expensive and vocational and so better suited to Masters level.

The case study undergraduate GIS programme has a different history. It began as a consequence of the availability of funding for recruiting staff during a period when the institution’s leading GIS expert was head of the Geography department. This resulted in the opening of a BSc in GIS in the early 1990s. Again, this illustrates the key role of individual champions, and circumstances. The early enthusiasts were vital in exploiting locally in their own HEIs the opportunities created by the national and international growth of the GIS industry.

In essence, therefore, the emergence of GIS provision owed much to the pioneering work of individuals in particular departments and to the support of the RRLs. From its origins principally at Master level, GIS education then “trickled down” to the undergraduate level typically in the form of optional Geography modules and (much more rarely) a full undergraduate GIS course.

5.3.2 GIS provision in the case study departments (CSDs)

In turning to modern-day provision within Geography degrees, the most common feature among the CSDs and more widely, is the existence of one or more named GIS modules. However, as indicated earlier, there is the possibility that some GIS teaching might be “hidden” within modules not bearing a GIS title. Indeed, as shown in Table 5.6, 4 out of the 6 CSDs placed some “taster” GIS teaching within a compulsory general Geography skills module in the first year. This ensures that all their undergraduates receive at least a modest exposure to GIS, that a basic introduction is provided which can assist students’ option choice later and that the GIS option(s) can be taught at a level which builds on the first year experience. The two CSDs which do not provide GIS in stage one gave interesting reasons for not doing so. In one case (CSD2), it was because the large stage one student numbers could not readily be accommodated in the GIS laboratory. In the other case (CSD3), the reason given related to time pressures on the specialist GIS staff member. In both cases, therefore, the desirability of a “taster” experience in stage one was recognized but outweighed by resourcing difficulties. In the four Geography degree programmes with some compulsory GIS at stage one, provision normally took the form of a weekly timetabled slot varying from two to ten weeks in duration.

Table 5.6: The nature of GIS provision in the UK CSDs (2010/11)

Type of Provision	CSD1 (pre-1992)	CSD2 (pre-1992)	CSD3 (pre-1992)	CSD4 (post-1992)	CSD5 (post-1992)	CSD6 (post-1992)
"Hidden" Stage One GIS teaching	+*	-	-	+	+	+
Mainstream± GIS module	+	+	+	-	+	+
Subject-specific± GIS module	+	-	+	-	+	-
GIS Master Programme	+	+	-	-	+	-
GIS Undergraduate Programme	-	-	-	+	-	-

* In CSD1 department, there is different approach between the BA and BSc programmes: although the BSc side has "hidden" GIS teaching in a skills module, on the BA side there is actually a small 10 credit stand-alone module.

± 'Mainstream' modules provide broad GIS coverage, whereas subject-specific modules focus on the use of GIS in a particular field.

As indicated above, in two of the six CSD Geography degrees, there was no compulsory GIS at all and only those students (a minority) who decided to choose the GIS optional module received any formal instruction in GIS. In these departments, GIS appeared to be seen as a rather specialized 'niche market' rather than an essential feature of a modern Geography education. This is somewhat at variance with the Geography Benchmark Statement (QAA 2000) which suggests that all students should have at least some training in GIS as an important and integral part of their Geography degree (Fraser 2005). This issue will be explored further in chapter 7.

With respect to the GIS modules at stage 2/3 in the CSDs, these are being taught on an optional basis available for all single honours students and most joint honours. The majority of modules are "mainstream" or standard modules providing a broad mix of general GIS theory and practice. However, a small minority have a "subject-specific" orientation, examining GIS in a particular field such as environmental management. Both these categories of options focus on developing GIS skills which might be useful both academically and in the GIS workplace. Being able to use GIS skills was seen as an important employability asset. Interestingly, a former lecturer in CSD6 noted that his optional GIS module was moved from Stage 3 to Stage 2 in order to allow students to use GIS in their final year dissertation projects, the research for which is often undertaken in the summer holidays between stage 2 and 3.

Table 5.7 provides a summary of the key organisational features of the Geography GIS modules (e.g. compulsory/optional, credit weightings) together with a brief statement on the module aims selected from the module handbooks. Discrete GIS modules in CSD2 and CSD6 are run throughout the whole year, whereas in the other CSDs they run for a semester. Within Geography degrees, because GIS modules are provided as options, student numbers vary between departments and from year to year. Modules vary in their size with 20 credits being about average (20 credits is one sixth of a student’s annual requirement and workload). Student recruitment depends on the modules’ perceived attractiveness, on the number of and relative appeal of the other options (e.g. in geomorphology, economic geography) and on the size of the total annual student cohort. Amongst our six CSDs, total Geography programme numbers per year ranged between 100 and 300 and the GIS modules attracted between 25 and 56 percentage of the full cohort. Typical student numbers in GIS options were in the 30-60 range. Overall, the GIS modules recruit about an average or typical share of students. Where there were both second and third year GIS modules, numbers tend to be a little lower in the final year. The staff interviewed were not entirely clear about the reasons for this, but perhaps some students simply wanted to try a different sub-disciplinary field before graduating.

Table 5.7: An overview of GIS modules in Undergraduate Geography Programmes(2010/11)

Departments	The Type of Modules	Structure of the Module	Aims
CSD1	The "stand alone" GIS module (BA)	Compulsory/10 Credits 10 weeks/ 1hr Lecture/2 hrs x 10 Practicals	The module aims to introduce students to the broad concept of Geographical Information Systems.
	The "Hidden" GIS teaching in skills module (BSc)	Compulsory/20 Credits 5 weeks/1hr Lecture/2 hrs x 5 Practicals	The course aims to introduce analytical skills in physical geography.
	Mainstream GIS module (BA)	Elective/ 10 Credits 10 Weeks/1 hr Lectures/2hrs x 6 Practicals	This module provides a solid grounding in the spatial analysis of secondary data that students might collect or encounter when undertaking projects or dissertation analysis. It explains and demonstrates the core concepts of GIS through lectures and allows students to develop their skills in using GIS and spatial analysis methods through practical classes.
	Mainstream GIS module (BSc)	Elective/ 10 Credits 10 Weeks/1 hr Lectures/2 hrs x 10 Practicals	This module looks at the many ways in which GIS can be applied to the study of the geosciences including modelling terrain, hydrology, ecology and land use.
	Subject-specificGIS module (BA)	Elective/20 Credits/ 10 Weeks/ 11 Weeks/ 1 hr Lectures/ 1 hr x 11 Practicals	This module aims to provide an understanding of the state of the art together with detailed insights into attribute and geographic data sources, GIS functions and applications in order to support a variety of planning tasks.
	Subject-specificGIS module (BSc)	Elective/20 Credits/ 10 Weeks/ 1 hr x 9 Lectures/ 2 hrs x 6Practicals	The module focuses in particular on human/environment interactions, dealing in turn with environmental impacts, current and proposed management strategies, wilderness preservation, sustainable development and national and international policy implications.
CSD2	Mainstream GIS module (BA/BSc)	Elective/30 Credits/ 20 Weeks/ 1 hr x 10 Lectures/ 2 hrs x 10 Practicals/ 10 Week Tutorial	This course aims to introduce the basic principles and applications of Geographic Information Systems (GIS).
CSD3	Mainstream GIS module (BA/BSc)	Elective/10 Credits/ 10 Weeks/ 2 hrs x 2 Lectures/ 2 hrs x 8 Practicals	This module aims to introduce students to the design and function of maps, and to teach the principles and applications of digital cartography and spatial analysis using Geographical Information Systems (GIS).
	Subject-specific GIS module (BA/BSc)	Elective/10 Credits/ 10 Weeks/2 hrs x 8 Lectures/ 2 hrs x 4 Practicals	The aim of the module is to examine human impacts on species and habitats at a range of spatial and temporal scales, using a combination of case studies, fieldwork and computer-based practicals.

Departments	The Type of Modules	Structure of the Module	Aims
CSD4	The "Hidden" GIS teaching in skills module (BSc)	Compulsory/40 Credits/ 5 Weeks/1 hrx 5 Lectures/ 2 hrs x 5 Practicals	You will meet professionals in geographically-relevant fields, and work with industry standard equipment and software, giving some insights into how you might apply your studies in later life.
CSD5	The "Hidden" GIS teaching in skills module (BA/BSc)	Compulsory/20 Credits/ 4 Weeks/1 hr x 4 Practicals	The aim of this modure is to develop a student's ability to conduct projects across a range of geographical fields.
	The "Hidden" GIS teaching in skills module (BA/BSc)	Compulsory/20 Credits/ 3 Weeks/1 hr x 3 Practicals	
	Mainstream GIS module (BA/BSc)	Elective/20 Credits/ 10 Weeks/1 hrx 10 Lectures/ 2 hrs x 10 Practicals	The aim of this module is to better understand mechanisms for acquiring, processing and communicating with geographical information.
	Subject-specific GIS module (BA/BSc)	Elective/30 Credits/ 10 Weeks/1 hr x 10 Lectures/ 3 hrs x 8 Practicals	This module will extend skills to analyse issues and problems in natural hazards.
CSD6	The "Hidden" GIS teaching in skills module (BA/BSc)	Compulsory/20 Credits/ 3 Weeks/1 hr x 3 Lectures/1 hr x 3 Practicals	To introduce the use of simple descriptive and inferential statistics and Geographic Information Systems. The fundamentals of human geography research, such as fieldwork, data analysis, GIS, presentation and report-writing, will be taught through a number of research projects.
	Mainstream GIS module (BA/BSc)	Elective/30 Credits/ 12 Weeks/1 hr x 12 Lectures/2 hrs x 12 Practicals/2hrs x 10 Tutorials	To develop a knowledge and a set of practical skills in the use of digital cartography and geographical information systems (GIS) and develop an understanding of applications of spatial analysis and decision support techniques in GIS.

Given that GIS is an applications-based subject by nature, students require at least some experience in the lab environment. However, the size of the cohort choosing the module might be larger than the number of workstations in the computer suite (see section 5.3.4). In this case, the lecturers often have to run the practical classes two or three times a week depending on how big the lab is and how many students are taking the module. Whilst five of the six CSDs prefer not to restrict the student numbers for the GIS module, CSD5 applies thirty as a definite limit for both the 2nd year and 3rd year GIS modules. This is because the size of the computer lab is not big enough to take more than 30 students at a single session.

Focusing on the 3rd year subject-specific modules in the CSDs, this type of GIS module is being offered by three CSDs (namely, CSD1, 3 and 5). The length of these modules is limited to a semester. These modules seem to have been designed with the particular aim of enabling the lecturer to focus on the use of GIS in their research field e.g. Biogeography. This provides an example of the research-led teaching approach referred to in chapter 2.

The number of credits for the GIS modules is shown in Table 5.8. When looking at the ratio of GIS modules' credits to the total credits for an Honours degree to be completed (360), the highest ratio is in CSD5 with 16.7 percent of the total UG credits, showing that up to about one sixth of a student's credits could be in GIS, if they opted for every GIS module. This is followed by CSD1 (BA side) and CSD6 both with 11.1 percent. It must be recognized, however, that calculating the maximum potential number of GIS module credits is only one rather crude way of assessing the role of GIS within a Geography programmes and may well in practice overstate its actual significance. Examining the minimum possible engagement a student could have across the six CSDs, by contrast, gives a range from zero to 2.8 percent of the students' curriculum. On average, a typical Geography student actually has between 6 and 34 of their 360 credits in GIS. However, this is again a rather crude estimate in that no account is taken of the occasional use of or reference to GIS in other modules (although this is unlikely to amount to much more than a tiny difference except perhaps when students use GIS in their project/dissertation). However dissertation use is likely to be concentrated amongst students taking a GIS module (they will have the expertise) and so may not widen much the pool of students with GIS skills and experience. What is clear is that in quantitative terms, GIS is generally only a very small part of the curriculum and of the students' learning experience. Moreover, given that four of the six CSDs in this study offer a GIS Masters or full GIS undergraduate programme, this selection of six Geography degrees may tend to overstate the importance of GIS because they have the expertise and facilities to function in this field and presumably consider it an important area of knowledge. So, if GIS is not a substantial part of the Geography curriculum in these departments, it probably tends to be generally still less important elsewhere.

Table 5.8: GIS Credits and their ratio to total credits in the CSDs

CSDs	Courses	Total Credits	Max. GIS Module Credits*	Min. GIS Module Credits*	Max. Ratio	Min. Ratio
CSD1	BA	360	40	10	11.1	2.8
CSD1	BSc	360	35	5	9.7	1.4
CSD2	BA/BSc	360	30	0	8.3	0.0
CSD3	BA/BSc	360	20	0	5.6	0.0
CSD4	BA/BSc	360	10	10	2.8	2.8
CSD5	BA/BSc	360	60	10	16.7	2.8
CSD6	BA/BSc	360	40	10	11.1	2.8

*Credits of "hidden" GIS teaching in skills modules are calculated on the basis of the proportion of the module which is focussed on GIS.

Other types of GIS provision in the CSDs

Apart from GIS modules in Geography degrees, there are two other types of GIS provision represented among the Case Study Departments; these being named GIS programmes at Masters and at undergraduate level (Wikle and Finchum 2003) Table 5.9 provides an overview of these programme. CSDs 1, 2, and 5 have a Masters programme dedicated to GIS teaching. Two of these three Masters programmes are in pre-1992 universities, with the other one in located within a post-1992 University. In addition, there is also an UG GIS programme in a post-1992 University (CSD4).

The GIS Masters degree programme in CSD1 presents itself as a GISystem-type degree programme, following a compulsory introduction, there are three specialist pathways from which students take one or two. This curriculum design illustrates what Wikle and Finchum (2003) refer to as a “specialization approach”. As well as a dissertation, this Masters programme in CSD1 also now includes a module featuring work-based learning that allows students to do GIS-related project in the real working environment.

The GIS programme in CSD2 has (in the Wikle and Finchum terminology) a “hierarchical approach”, with a scheduled sequence of compulsory modules each taken in turn. This is efficient because there are no options or electives, so students do not get the benefits of choice but there is a clear progression, each module underpinning the next. Although there is a dissertation, unlike the programme in CSD1, this has no work-placement module, the reason given being that many of the students are part time and already have a job using GIS.

The third MSc programme (CSD5) adopts a variant of the “hierarchical approach”. There is a single compulsory pathway which students must follow during the first term with options later. This mixed model provides a balance between resource efficiencies (whole cohort teaching) in term one and student choice thereafter in the form of optional modules and the project. In this programme, there is also an optional work-placement module.

The GIS Undergraduate programme (CSD4) has a duration of three years. It involves 10 mandatory modules and 9 optional modules from which students choose. Some of the options are also available to students in the Geography degree, which thereby brings both potentially efficiencies and curriculum breadth. However, it is rare in practice for Geography students to take any GIS modules, perhaps in part because if they were strongly interested in GIS, they would have enrolled at the start for the full GIS programme.

The size of the cohort on each Masters programme varies. Programme Coordinators (PCs) in CSD1 and CSD2 indicated that the expected annual intake for their Masters programmes is between 20 and 30. In 2011, CSD1 and CSD2 recruited 15 students and 30 students, respectively. However, CSD5 recruited only 2 Masters students for the same year and in 2011/12 closed its Masters programme. Moreover, it should also be emphasised that each year particularly in the CSD1 and CSD2, few students Geography are proceeding through to Masters GIS study (typically only one or two). Regarding the GIS UG programme, recruitment numbers have been declining for the last three years. In 2010, 7 students enrolled on the programme, below the target number of 10. The University has therefore made a decision that this programme would not recruit new students in 2011/12.

Unlike the Geography departments in the pre-1992 universities with a longer GIS history, the departments in CSD4 and CSD5 have been struggling to recruit enough students to sustain their Masters and UG GIS degree programmes. As highlighted above, these two did not accept students for 2011/12. In the opinions of the lecturers interviewed, there are four main drivers behind the closure of the Masters course. Firstly, undergraduates now emerging with considerable financial debts are reluctant to incur the extra costs of a Masters programme (typical fees in 2010/11 were about £4,200). Secondly, the tighter visa regime for international students is becoming an obstacle. Thirdly, in a period of economic recession, employees are reluctant to sponsor or support staff considering doing a Masters (full-time or part-time). Finally, the increasing pressures on HE budgets make institutions reluctant to subsidize courses with recruitment problems. These are all compelling factors, but it has to be recognized that they could apply to almost all Masters provision across the full range of disciplines and the UK has not yet seen major declines in Master student numbers (though this may yet come with the introduction of higher undergraduate and postgraduate fees, and a tighter visa regime). At this stage, although it is uncertain as to whether GIS Masters provision will be a major casualty, there are clearly some worrying signs. For example, recruitment for the GIS CSD1 Masters has fallen for the past two years and in 2011/12 six overseas students offered places did not enrol for a mixture of visa and financial reasons. With respect to the closure of the GIS undergraduate course, the one important reason for the decline in recruitment would appear to be the nature of the programme with a strong focus on surveying-type modules. Moreover, the numbers of staff required to run the programme have made it costly to run – an increasingly key factor in an era of austerity and budget cuts.

Table 5.9: An overview of GIS degree programmes in the CSDs (2010/11)

Departments	The type of the programme	The number of modules	The length of the programme	The start date of the course	Type of structure
CSD1	MSc/MA in GISystems	2 core modules (per 15 credits)/ 6 optional modules (each 15 credits) under the three streams +Masters project (60 credits)	8 months for PG Dip 12 months for PG Cert 18 months for MSc	The early 1990s	Specialisation approach
CSD2	MSc in GIScience	6 core modules (per 20 credits) +Masters project (60 credits)	8 months for PG Dip 12 months for PG Cert 18 months for MSc	The early 1990s	Hierarchical approach
CSD5	Combined MSc in GISystems	6 (per 15 credits) mandatory/5 (per 15 credits) optional modules+ Masters project (60 credits)	8 months for PG Dip 12 months for PG Cert 18 months for MSc	The mid of 2000	Hierarchical approach but with some options
CSD4	BSc in GISystems	10 core modules (240 credits)+9 optional modules (each 20 credits)	3 years for BSc	The early 1990s	Hierarchical approach

5.3.3 The GIS curriculum of the Geography modules

This section focuses on the GIS curriculum within the Geography programmes and in particular on the extent to which their contents match the Body of Knowledge (BoK) which, as explained in chapter three, is the most up-to-date and comprehensive GIS curriculum guide (see also Table 5.15).

In order to respond to questions related to mapping the module and programme contents against BoK, a table originally designed for this purposes by Prager and Brewe (2009) has been adapted. This table addresses the whole content of BoK: the two main columns show the Knowledge Areas (KA), the cells refer to the units of the Knowledge Areas and the bold linings identify the core cells. The shaded scale shows the total number of modules across the CSDs which address the unit of knowledge areas. The empty cell(s) (white coloured) are unaddressed areas in the BoK. It is not essential for the reader to explore the details of these tables (the key points are summarised in the text) but those wishing to do so should consult the key in Table 5.15.

Regarding the “hidden” GIS teaching in the first year, Table 5.10 shows that the areas and units from the BoK addressed in this teaching are mainly ‘Analytical Methods (AM)’ and ‘Cartographic Visualisation’ (CV). The rather darker shades are specifically core units such as AM4 (Basic Analytical Operations), CV2 (Data Consideration) and CV3 (Principles of map design), meaning that these units are addressed by more than one module. However, occasionally modules addressed a few less common themes such as OI3 (Organizational Structures and Strategies) depending usually on the realm of the lecturer’s personal research interests.

It should be acknowledged that although the teaching in the various CSDs may focus on similar areas in the BoK syllabus, the precise topics covered can be different, for example, with a department strong on environmental subjects, using a GIS application relating to the mapping of soil types. The detailed content of the “hidden” GIS teaching thus varies from department to department and programme to programme. The key point is that they have delivered on the semi-application based design, meaning that they introduced the basic theory and concepts of GIS, such as mapping, projections, data structure and the GIS fundamentals, and these are followed by some practicals often going hand-in-hand with theoretical aspects. Overall, the Stage One Geography provision is reasonably aligned with the ideas set out in the Body of Knowledge, not least because a few units (with bold linings) in core areas of the BoK are covered. It also seeks to underpin the subsequent GIS options.

For second year mainstream GIS options (Table 5.11), the common feature is that they are obviously more intensive and longer than the “hidden” GIS teaching in the first year. The curriculum foci in these modules are on BoK areas such as AM (Basic Analytical Operations), CV (Cartography and Visualisation), DA (Design Aspect) and GD (Geospatial Data). In particular, within these modules, sub-units of AM and CV have been emphasised. Interestingly, the module in CSD6 has a unique unit involving Critical GIS in the GS (GI S&T and Society) knowledge area. In addition, the module in CSD5 has addressed a subject dealing with Remote Sensing, namely the BoK unit GD11-1 and GD11-3 (Geospatial Data). A few sub-parts of the unit entitled Analysis of Surface (AM6) are also emphasised in the mainstream modules (Table 5.11). Nevertheless, the contents of mainstream modules are obviously still insufficient to cover all the BoK core units. The similarities between the areas covered in stage 1 GIS teaching and the mainstream GIS options might be because in first year modules lecturers try to give breadth so they cover a wide variety of GIS subjects but at an introductory level. The majority of options seem to have focused on broadly similar units, thus their contents are fairly comparable. There are not major curriculum differences between the CSDs.

By contrast, the third year subject-specific GIS modules are much more diverse and cover different subject themes, responding to the lecturer's specialism and research interests. The most common feature is a focus on the CV (Cartography and Visualisation) knowledge area and specifically on CV6-3 Map interpretation and CV6-4 Map analysis (Table 5.12).

Overall, when comparing all these GIS modules, there seems to be a substantial amount in common across the CSDs. This is because they all use similar techniques to analyse spatial data and to create maps. On the other hand, there are some differences regarding the geographical subject matter on which the teaching is focussed. However, in comparison with the BoK it is true to say that such issues as web-based GIS, mobile-GIS and Open sources (data and software) are not given much attention. It is also true that no single Geography module came even close to covering all the core units in the Body of Knowledge. This obviously reflects the small amount of time the CSD Geography degree devoted to GIS.

Table 5.10: An illustration of mapping the Geography Stage One GIS curriculum against Body of Knowledge and "familiar" units in the Body of Knowledge (BoK) (format adapted from Prager and Plewe 2009)

									KA
							AM1-2	AM1-1	AM
						AM2-3	AM2-2	AM2-1	
		AM3-6	AM3-5	AM3-4	AM3-3	AM3-2	AM3-1		
				AM4-4	AM4-3	AM4-2	AM4-1		
	AM5-8	AM5-7	AM5-6	AM5-5	AM5-4	AM5-3	AM5-2	AM5-1	
				AM6-5	AM6-4	AM6-3	AM6-2	AM6-1	
	AM7-8	AM7-7	AM7-6	AM7-5	AM7-4	AM7-3	AM7-2	AM7-1	
				AM8-5	AM8-4	AM8-3	AM8-2	AM8-1	
					AM9-4	AM9-3	AM9-2	AM9-1	
					AM10-4	AM10-3	AM10-2	AM10-1	
		AM11-7	AM11-6	AM11-5	AM11-4	AM11-3	AM11-2	AM11-1	
					AM12-4	AM12-3	AM12-2	AM12-1	
						CF1-3	CF1-2	CF1-1	CF
		CF2-7	CF2-6	CF2-5	CF2-4	CF2-3	CF2-2	CF2-1	
					CF3-4	CF3-3	CF3-2	CF3-1	
					CF4-4	CF4-3	CF4-2	CF4-1	
	CF5-8	CF5-7	CF5-6	CF5-5	CF5-4	CF5-3	CF5-2	CF5-1	
					CF6-4	CF6-3	CF6-2	CF6-1	
							CV1-2	CV1-1	CV
						CV2-3	CV2-2	CV2-1	
					CV3-4	CV3-3	CV3-2	CV3-1	
CV4-9	CV4-8	CV4-7	CV4-6	CV4-5	CV4-4	CV4-3	CV4-2	CV4-1	
						CV5-3	CV5-2	CV5-1	
		CV6-7	CV6-6	CV6-5	CV6-4	CV6-3	CV6-2	CV6-1	
				DA1-5	DA1-4	DA1-3	DA1-2	DA1-1	DA
				DA2-5	DA2-4	DA2-3	DA2-2	DA2-1	
			DA3-6	DA3-5	DA3-4	DA3-3	DA3-2	DA3-1	
					DA4-4	DA4-3	DA4-2	DA4-1	
					DA5-4	DA5-3	DA5-2	DA5-1	
					DA6-4	DA6-3	DA6-2	DA6-1	
					DA7-4	DA7-3	DA7-2	DA7-1	
							DM1-2	DM1-1	DM
					DM2-4	DM2-3	DM2-2	DM2-1	
	DM3-8	DM3-7	DM3-6	DM3-5	DM3-4	DM3-3	DM3-2	DM3-1	
	DM4-8	DM4-7	DM4-6	DM4-5	DM4-4	DM4-3	DM4-2	DM4-1	
						DM5-3	DM5-2	DM5-1	

KA									
DN	DN1-1	DN1-2	DN1-3	DN1-4	DN1-5	DN1-6			
	DN2-1	DN2-2	DN2-3	DN2-4					
	DN3-1	DN3-2	DN3-3	DN3-4					
GC	GC1-1	GC1-2							
	GC2-1	GC2-2	GC2-3	GC2-4	GC2-5	GC2-6	GC2-7	GC2-8	GC2-9
	GC3-1	GC3-2	GC3-3	GC3-4	GC3-5				
	GC4-1	GC4-2	GC4-3	GC4-4	GC4-5				
	GC5-1	GC5-2							
	GC6-1	GC6-2	GC6-3	GC6-4	GC6-5				
	GC7-1								
	GC8-1	GC8-2	GC8-3	GC8-4	GC8-5	GC8-6			
	GC9-1	GC9-2	GC9-3	GC9-4	GC9-5				
GD	GD1-1	GD1-2	GD1-3						
	GD2-1	GD2-2							
	GD3-1	GD3-2	GD3-3	GD3-4					
	GD4-1	GD4-2							
	GD5-1	GD5-2	GD5-3	GD5-4					
	GD6-1	GD6-2	GD6-3	GD6-4	GD6-5				
	GD7-1	GD7-2	GD7-3						
	GD8-1	GD8-2	GD8-3						
	GD9-1	GD9-2	GD9-3	GD9-4					
	GD10-1	GD10-2	GD10-3	GD10-4	GD10-5	GD10-6			
	GD11-1	GD11-2	GD11-3	GD11-4	GD11-5				
	GD12-1	GD12-2	GD12-3	GD12-4	GD12-5	GD12-6			
GS	GS1-1	GS1-2	GS1-3	GS1-4					
	GS2-1	GS2-2	GS2-3	GS2-4	GS2-5				
	GS3-1	GS3-2	GS3-3						
	GS4-1	GS4-2	GS4-3						
	GS5-1	GS5-2	GS5-3	GS5-4					
	GS6-1	GS6-2							
	GS7-1	GS7-2	GS7-3	GS7-4					
OI	OI1-1	OI1-2	OI1-3	OI1-4	OI1-5				
	OI2-1	OI2-2	OI2-3	OI2-4	OI2-5	OI2-6			
	OI3-1	OI3-2	OI3-3						
	OI4-1	OI4-2	OI4-3	OI4-4					
	OI5-1	OI5-2	OI5-3	OI5-4	OI5-5	OI5-6	OI5-7	OI5-8	
	OI6-1	OI6-2	OI6-3	OI6-4	OI6-5	OI6-6			

The number of modules

0	
1	
2	
3	
4	

Rows showing the Knowledge Areas
Bold cells showing the Core Areas Units
Cells showing the Topics

Table 5.11: An illustration of mapping the Geography 2nd and/or 3rd year mainstream GIS modules against Body of Knowledge and "familiar" units in the BoK (format adapted from Prager and Plewe 2009)

									KA	KA									
							AM1-2	AM1-1			DN1-1	DN1-2	DN1-3	DN1-4	DN1-5	DN1-6			
						AM2-3	AM2-2	AM2-1		DN	DN2-1	DN2-2	DN2-3	DN2-4					
			AM3-6	AM3-5	AM3-4	AM3-3	AM3-2	AM3-1			DN3-1	DN3-2	DN3-3	DN3-4					
					AM4-4	AM4-3	AM4-2	AM4-1			GC1-1	GC1-2							
	AM5-8	AM5-7	AM5-6	AM5-5	AM5-4	AM5-3	AM5-2	AM5-1			GC2-1	GC2-2	GC2-3	GC2-4	GC2-5	GC2-6	GC2-7	GC2-8	GC2-9
				AM6-5	AM6-4	AM6-3	AM6-2	AM6-1	AM		GC3-1	GC3-2	GC3-3	GC3-4	GC3-5				
	AM7-8	AM7-7	AM7-6	AM7-5	AM7-4	AM7-3	AM7-2	AM7-1			GC4-1	GC4-2	GC4-3	GC4-4	GC4-5				
				AM8-5	AM8-4	AM8-3	AM8-2	AM8-1		GC	GC5-1	GC5-2							
					AM9-4	AM9-3	AM9-2	AM9-1			GC6-1	GC6-2	GC6-3	GC6-4	GC6-5				
					AM10-4	AM10-3	AM10-2	AM10-1			GC7-1								
		AM11-7	AM11-6	AM11-5	AM11-4	AM11-3	AM11-2	AM11-1			GC8-1	GC8-2	GC8-3	GC8-4	GC8-5	GC8-6			
					AM12-4	AM12-3	AM12-2	AM12-1			GC9-1	GC9-2	GC9-3	GC9-4	GC9-5				
						CF1-3	CF1-2	CF1-1			GD1-1	GD1-2	GD1-3						
		CF2-7	CF2-6	CF2-5	CF2-4	CF2-3	CF2-2	CF2-1			GD2-1	GD2-2							
					CF3-4	CF3-3	CF3-2	CF3-1	CF		GD3-1	GD3-2	GD3-3	GD3-4					
					CF4-4	CF4-3	CF4-2	CF4-1			GD4-1	GD4-2							
	CF5-8	CF5-7	CF5-6	CF5-5	CF5-4	CF5-3	CF5-2	CF5-1			GD5-1	GD5-2	GD5-3	GD5-4					
					CF6-4	CF6-3	CF6-2	CF6-1		GD	GD6-1	GD6-2	GD6-3	GD6-4	GD6-5				
							CV1-2	CV1-1			GD7-1	GD7-2	GD7-3						
						CV2-3	CV2-2	CV2-1			GD8-1	GD8-2	GD8-3						
					CV3-4	CV3-3	CV3-2	CV3-1	CV		GD9-1	GD9-2	GD9-3	GD9-4					
CV4-9	CV4-8	CV4-7	CV4-6	CV4-5	CV4-4	CV4-3	CV4-2	CV4-1			GD10-1	GD10-2	GD10-3	GD10-4	GD10-5	GD10-6			
						CV5-3	CV5-2	CV5-1			GD11-1	GD11-2	GD11-3	GD11-4	GD11-5				
		CV6-7	CV6-6	CV6-5	CV6-4	CV6-3	CV6-2	CV6-1			GD12-1	GD12-2	GD12-3	GD12-4	GD12-5	GD12-6			
				DA1-5	DA1-4	DA1-3	DA1-2	DA1-1			GS1-1	GS1-2	GS1-3	GS1-4					
				DA2-5	DA2-4	DA2-3	DA2-2	DA2-1			GS2-1	GS2-2	GS2-3	GS2-4	GS2-5				
			DA3-6	DA3-5	DA3-4	DA3-3	DA3-2	DA3-1			GS3-1	GS3-2	GS3-3						
					DA4-4	DA4-3	DA4-2	DA4-1	DA	GS	GS4-1	GS4-2	GS4-3						
					DA5-4	DA5-3	DA5-2	DA5-1			GS5-1	GS5-2	GS5-3	GS5-4					
					DA6-4	DA6-3	DA6-2	DA6-1			GS6-1	GS6-2							
					DA7-4	DA7-3	DA7-2	DA7-1			GS7-1	GS7-2	GS7-3	GS7-4					
							DM1-2	DM1-1			OI1-1	OI1-2	OI1-3	OI1-4	OI1-5				
					DM2-4	DM2-3	DM2-2	DM2-1			OI2-1	OI2-2	OI2-3	OI2-4	OI2-5	OI2-6			
	DM3-8	DM3-7	DM3-6	DM3-5	DM3-4	DM3-3	DM3-2	DM3-1	DM		OI3-1	OI3-2	OI3-3						
	DM4-8	DM4-7	DM4-6	DM4-5	DM4-4	DM4-3	DM4-2	DM4-1		OI	OI4-1	OI4-2	OI4-3	OI4-4					
						DM5-3	DM5-2	DM5-1			OI5-1	OI5-2	OI5-3	OI5-4	OI5-5	OI5-6	OI5-7	OI5-8	
											OI6-1	OI6-2	OI6-3	OI6-4	OI6-5	OI6-6			

The number of modules	
0	
1	
2	
3	
4	
5	

Rows showing the Knowledge Areas
Bold cells showing the Core Areas Units
Cells showing the Units

Table 5.12: An illustration of mapping the Geography subject-specific GIS modules against Body of Knowledge and "familiar" units in the BoK (format adapted from Prager and Plewe 2009)

									KA
							AM1-2	AM1-1	AM
						AM2-3	AM2-2	AM2-1	
			AM3-6	AM3-5	AM3-4	AM3-3	AM3-2	AM3-1	
					AM4-4	AM4-3	AM4-2	AM4-1	
	AM5-8	AM5-7	AM5-6	AM5-5	AM5-4	AM5-3	AM5-2	AM5-1	
				AM6-5	AM6-4	AM6-3	AM6-2	AM6-1	
	AM7-8	AM7-7	AM7-6	AM7-5	AM7-4	AM7-3	AM7-2	AM7-1	
				AM8-5	AM8-4	AM8-3	AM8-2	AM8-1	
					AM9-4	AM9-3	AM9-2	AM9-1	
					AM10-4	AM10-3	AM10-2	AM10-1	
		AM11-7	AM11-6	AM11-5	AM11-4	AM11-3	AM11-2	AM11-1	
					AM12-4	AM12-3	AM12-2	AM12-1	
						CF1-3	CF1-2	CF1-1	CF
		CF2-7	CF2-6	CF2-5	CF2-4	CF2-3	CF2-2	CF2-1	
					CF3-4	CF3-3	CF3-2	CF3-1	
					CF4-4	CF4-3	CF4-2	CF4-1	
	CF5-8	CF5-7	CF5-6	CF5-5	CF5-4	CF5-3	CF5-2	CF5-1	
					CF6-4	CF6-3	CF6-2	CF6-1	
							CV1-2	CV1-1	CV
						CV2-3	CV2-2	CV2-1	
					CV3-4	CV3-3	CV3-2	CV3-1	
CV4-9	CV4-8	CV4-7	CV4-6	CV4-5	CV4-4	CV4-3	CV4-2	CV4-1	
						CV5-3	CV5-2	CV5-1	
		CV6-7	CV6-6	CV6-5	CV6-4	CV6-3	CV6-2	CV6-1	
				DA1-5	DA1-4	DA1-3	DA1-2	DA1-1	DA
				DA2-5	DA2-4	DA2-3	DA2-2	DA2-1	
			DA3-6	DA3-5	DA3-4	DA3-3	DA3-2	DA3-1	
					DA4-4	DA4-3	DA4-2	DA4-1	
					DA5-4	DA5-3	DA5-2	DA5-1	
					DA6-4	DA6-3	DA6-2	DA6-1	
					DA7-4	DA7-3	DA7-2	DA7-1	
							DM1-2	DM1-1	DM
					DM2-4	DM2-3	DM2-2	DM2-1	
	DM3-8	DM3-7	DM3-6	DM3-5	DM3-4	DM3-3	DM3-2	DM3-1	
	DM4-8	DM4-7	DM4-6	DM4-5	DM4-4	DM4-3	DM4-2	DM4-1	
						DM5-3	DM5-2	DM5-1	

KA									
DN	DN1-1	DN1-2	DN1-3	DN1-4	DN1-5	DN1-6			
	DN2-1	DN2-2	DN2-3	DN2-4					
	DN3-1	DN3-2	DN3-3	DN3-4					
GC	GC1-1	GC1-2							
	GC2-1	GC2-2	GC2-3	GC2-4	GC2-5	GC2-6	GC2-7	GC2-8	GC2-9
	GC3-1	GC3-2	GC3-3	GC3-4	GC3-5				
	GC4-1	GC4-2	GC4-3	GC4-4	GC4-5				
	GC5-1	GC5-2							
	GC6-1	GC6-2	GC6-3	GC6-4	GC6-5				
	GC7-1								
	GC8-1	GC8-2	GC8-3	GC8-4	GC8-5	GC8-6			
	GC9-1	GC9-2	GC9-3	GC9-4	GC9-5				
GD	GD1-1	GD1-2	GD1-3						
	GD2-1	GD2-2							
	GD3-1	GD3-2	GD3-3	GD3-4					
	GD4-1	GD4-2							
	GD5-1	GD5-2	GD5-3	GD5-4					
	GD6-1	GD6-2	GD6-3	GD6-4	GD6-5				
	GD7-1	GD7-2	GD7-3						
	GD8-1	GD8-2	GD8-3						
	GD9-1	GD9-2	GD9-3	GD9-4					
	GD10-1	GD10-2	GD10-3	GD10-4	GD10-5	GD10-6			
	GD11-1	GD11-2	GD11-3	GD11-4	GD11-5				
	GD12-1	GD12-2	GD12-3	GD12-4	GD12-5	GD12-6			
GS	GS1-1	GS1-2	GS1-3	GS1-4					
	GS2-1	GS2-2	GS2-3	GS2-4	GS2-5				
	GS3-1	GS3-2	GS3-3						
	GS4-1	GS4-2	GS4-3						
	GS5-1	GS5-2	GS5-3	GS5-4					
	GS6-1	GS6-2							
	GS7-1	GS7-2	GS7-3	GS7-4					
OI	OI1-1	OI1-2	OI1-3	OI1-4	OI1-5				
	OI2-1	OI2-2	OI2-3	OI2-4	OI2-5	OI2-6			
	OI3-1	OI3-2	OI3-3						
	OI4-1	OI4-2	OI4-3	OI4-4					
	OI5-1	OI5-2	OI5-3	OI5-4	OI5-5	OI5-6	OI5-7	OI5-8	
	OI6-1	OI6-2	OI6-3	OI6-4	OI6-5	OI6-6			

The number of modules
0
1
2
3

Rows showing the Knowledge Areas
Bold cells showing the Core Areas Units
Cells showing the Units

GIS in the other programmes

All three Masters programmes have an introductory module featuring basic GIS concepts and spatial analysis techniques to bring the students who did not enrol with any GIS background up to a level at which they can cope with a GIS Masters programme. However, in comparison with the UG GIS modules in Geography programmes, modules at the Masters level are clearly more advanced and involve more complex subjects such as programming and web-based GIS.

When looking at their curriculum content, Analytical Methods (AM), Cartography and Visualization (CV), Geospatial Data (GD) and Design Aspects (DA) are among the important knowledge areas that are addressed by the Masters level programmes. The detailed unit classifications of programmes have been illustrated in Table 5.13. A distinctive part of the GIS Masters syllabus in CSD1 is the availability of Geocomputation (GC) which is not an area that is embodied as a core unit in the Body of Knowledge. This illustrates the potential for Masters courses occasionally to go beyond the Body of Knowledge (see Table 5.15).

Unlike the Masters GIS programmes, the BSc in GISystems places much more emphasis on the Design Aspects (DA) and Organizational and Institutional Aspects (OI), not least because the programme has a stand-alone Project Management module featuring some practical aspects in the sector (although interestingly it does not include any Project Management software experience such as Prince or MS Project Manager). This programme also has a strong Geospatial Data dimension, with a focus on first-hand data collection activities in the field (Table 5.14).

In contrast to the UG Geography and UG GIS programmes, GIS Masters degrees include such complex issues as programming, customising the package software and creating web-based maps on GIS. In essence, therefore, the Masters GIS programmes are more intensive and comprehensive compared to the UG programmes. They are both deeper and broader. They run a much more diverse set of modules and their students must also complete a GIS project for their Masters thesis which is typically 15-20,000 words in length.

Comparison between the Masters and the UG GIS programme provision reveals a tension. A three-year GIS degree has potentially the time to cover a lot more ground (and perhaps even to go deeper) than a one year GIS Masters. However, this is not apparent from the CSDs programmes. Although there are a few similarities between the UG GIS programme and the Masters programmes such as CV and GD, such knowledge areas as AM, CF, DN and CS are not covered in the full GIS programme (see Table 5.15). With respect to curriculum breadth, the Masters courses seem to overtake the UG GIS programme. However, with respect to the depth the issue is arguable, and will be discussed in more detail in the next chapter.

When comparing the UG GIS programme with the Geography modules, it is obviously the case that the BSc on GIS covers a broader range of topics, such as OI, DM and GD (Table 5.14). Another difference is that the final year project must be GIS focussed, which is not the case in Geography. The GIS programme also give more attention to research and surveying techniques such as first-hand data collection from the field with appropriate equipment. Thus, whereas Geography students are generally working with secondary data coming through the Ordnance Survey and lecturers' own research, GIS students are often expected to work with first hand data collected from the field. A three year programme appears to offer the time available to enable this kind of field-based approach.

Table 5.13: An illustration of mapping Masters GIS programmes' contents against the Body of Knowledge and "familiar" units in the BoK (format adapted from Prager and Plewe 2009)

									KA
							AM1-2	AM1-1	AM
						AM2-3	AM2-2	AM2-1	AM
			AM3-6	AM3-5	AM3-4	AM3-3	AM3-2	AM3-1	AM
					AM4-4	AM4-3	AM4-2	AM4-1	AM
	AM5-8	AM5-7	AM5-6	AM5-5	AM5-4	AM5-3	AM5-2	AM5-1	AM
				AM6-5	AM6-4	AM6-3	AM6-2	AM6-1	AM
	AM7-8	AM7-7	AM7-6	AM7-5	AM7-4	AM7-3	AM7-2	AM7-1	AM
				AM8-5	AM8-4	AM8-3	AM8-2	AM8-1	AM
					AM9-4	AM9-3	AM9-2	AM9-1	AM
					AM10-4	AM10-3	AM10-2	AM10-1	AM
		AM11-7	AM11-6	AM11-5	AM11-4	AM11-3	AM11-2	AM11-1	AM
					AM12-4	AM12-3	AM12-2	AM12-1	AM
						CF1-3	CF1-2	CF1-1	CF
		CF2-7	CF2-6	CF2-5	CF2-4	CF2-3	CF2-2	CF2-1	CF
					CF3-4	CF3-3	CF3-2	CF3-1	CF
					CF4-4	CF4-3	CF4-2	CF4-1	CF
	CF5-8	CF5-7	CF5-6	CF5-5	CF5-4	CF5-3	CF5-2	CF5-1	CF
					CF6-4	CF6-3	CF6-2	CF6-1	CF
							CV1-2	CV1-1	CV
						CV2-3	CV2-2	CV2-1	CV
					CV3-4	CV3-3	CV3-2	CV3-1	CV
CV4-9	CV4-8	CV4-7	CV4-6	CV4-5	CV4-4	CV4-3	CV4-2	CV4-1	CV
						CV5-3	CV5-2	CV5-1	CV
		CV6-7	CV6-6	CV6-5	CV6-4	CV6-3	CV6-2	CV6-1	CV
				DA1-5	DA1-4	DA1-3	DA1-2	DA1-1	DA
				DA2-5	DA2-4	DA2-3	DA2-2	DA2-1	DA
			DA3-6	DA3-5	DA3-4	DA3-3	DA3-2	DA3-1	DA
					DA4-4	DA4-3	DA4-2	DA4-1	DA
					DA5-4	DA5-3	DA5-2	DA5-1	DA
					DA6-4	DA6-3	DA6-2	DA6-1	DA
					DA7-4	DA7-3	DA7-2	DA7-1	DA
							DM1-2	DM1-1	DM
					DM2-4	DM2-3	DM2-2	DM2-1	DM
	DM3-8	DM3-7	DM3-6	DM3-5	DM3-4	DM3-3	DM3-2	DM3-1	DM
	DM4-8	DM4-7	DM4-6	DM4-5	DM4-4	DM4-3	DM4-2	DM4-1	DM
						DM5-3	DM5-2	DM5-1	DM

KA									
DN	DN1-1	DN1-2	DN1-3	DN1-4	DN1-5	DN1-6			
DN	DN2-1	DN2-2	DN2-3	DN2-4					
DN	DN3-1	DN3-2	DN3-3	DN3-4					
GC	GC1-1	GC1-2							
GC	GC2-1	GC2-2	GC2-3	GC2-4	GC2-5	GC2-6	GC2-7	GC2-8	GC2-9
GC	GC3-1	GC3-2	GC3-3	GC3-4	GC3-5				
GC	GC4-1	GC4-2	GC4-3	GC4-4	GC4-5				
GC	GC5-1	GC5-2							
GC	GC6-1	GC6-2	GC6-3	GC6-4	GC6-5				
GC	GC7-1								
GC	GC8-1	GC8-2	GC8-3	GC8-4	GC8-5	GC8-6			
GC	GC9-1	GC9-2	GC9-3	GC9-4	GC9-5				
GD	GD1-1	GD1-2	GD1-3						
GD	GD2-1	GD2-2							
GD	GD3-1	GD3-2	GD3-3	GD3-4					
GD	GD4-1	GD4-2							
GD	GD5-1	GD5-2	GD5-3	GD5-4					
GD	GD6-1	GD6-2	GD6-3	GD6-4	GD6-5				
GD	GD7-1	GD7-2	GD7-3						
GD	GD8-1	GD8-2	GD8-3						
GD	GD9-1	GD9-2	GD9-3	GD9-4					
GD	GD10-1	GD10-2	GD10-3	GD10-4	GD10-5	GD10-6			
GD	GD11-1	GD11-2	GD11-3	GD11-4	GD11-5				
GD	GD12-1	GD12-2	GD12-3	GD12-4	GD12-5	GD12-6			
GS	GS1-1	GS1-2	GS1-3	GS1-4					
GS	GS2-1	GS2-2	GS2-3	GS2-4	GS2-5				
GS	GS3-1	GS3-2	GS3-3						
GS	GS4-1	GS4-2	GS4-3						
GS	GS5-1	GS5-2	GS5-3	GS5-4					
GS	GS6-1	GS6-2							
GS	GS7-1	GS7-2	GS7-3	GS7-4					
OI	OI1-1	OI1-2	OI1-3	OI1-4	OI1-5				
OI	OI2-1	OI2-2	OI2-3	OI2-4	OI2-5	OI2-6			
OI	OI3-1	OI3-2	OI3-3						
OI	OI4-1	OI4-2	OI4-3	OI4-4					
OI	OI5-1	OI5-2	OI5-3	OI5-4	OI5-5	OI5-6	OI5-7	OI5-8	
OI	OI6-1	OI6-2	OI6-3	OI6-4	OI6-5	OI6-6			

The number of GIS MSc courses

0	
1	
2	
3	

Rows showing the Knowledge Areas
Bold cells showing the Core Areas Units
Cells showing the Units

Table 5.14: An illustration of mapping the UG GIS programme's contents against the Body of Knowledge and "familiar" units in the BoK (format adapted from Prager and Plewe 2009)

									KA	KA									
							AM1-2	AM1-1			DN1-1	DN1-2	DN1-3	DN1-4	DN1-5	DN1-6			
						AM2-3	AM2-2	AM2-1		DN	DN2-1	DN2-2	DN2-3	DN2-4					
			AM3-6	AM3-5	AM3-4	AM3-3	AM3-2	AM3-1			DN3-1	DN3-2	DN3-3	DN3-4					
					AM4-4	AM4-3	AM4-2	AM4-1			GC1-1	GC1-2							
	AM5-8	AM5-7	AM5-6	AM5-5	AM5-4	AM5-3	AM5-2	AM5-1			GC2-1	GC2-2	GC2-3	GC2-4	GC2-5	GC2-6	GC2-7	GC2-8	GC2-9
				AM6-5	AM6-4	AM6-3	AM6-2	AM6-1	AM		GC3-1	GC3-2	GC3-3	GC3-4	GC3-5				
	AM7-8	AM7-7	AM7-6	AM7-5	AM7-4	AM7-3	AM7-2	AM7-1			GC4-1	GC4-2	GC4-3	GC4-4	GC4-5				
				AM8-5	AM8-4	AM8-3	AM8-2	AM8-1		GC	GC5-1	GC5-2							
					AM9-4	AM9-3	AM9-2	AM9-1			GC6-1	GC6-2	GC6-3	GC6-4	GC6-5				
					AM10-4	AM10-3	AM10-2	AM10-1			GC7-1								
		AM11-7	AM11-6	AM11-5	AM11-4	AM11-3	AM11-2	AM11-1			GC8-1	GC8-2	GC8-3	GC8-4	GC8-5	GC8-6			
					AM12-4	AM12-3	AM12-2	AM12-1			GC9-1	GC9-2	GC9-3	GC9-4	GC9-5				
						CF1-3	CF1-2	CF1-1			GD1-1	GD1-2	GD1-3						
		CF2-7	CF2-6	CF2-5	CF2-4	CF2-3	CF2-2	CF2-1			GD2-1	GD2-2							
					CF3-4	CF3-3	CF3-2	CF3-1	CF		GD3-1	GD3-2	GD3-3	GD3-4					
					CF4-4	CF4-3	CF4-2	CF4-1			GD4-1	GD4-2							
	CF5-8	CF5-7	CF5-6	CF5-5	CF5-4	CF5-3	CF5-2	CF5-1			GD5-1	GD5-2	GD5-3	GD5-4					
					CF6-4	CF6-3	CF6-2	CF6-1			GD6-1	GD6-2	GD6-3	GD6-4	GD6-5				
							CV1-2	CV1-1		GD	GD7-1	GD7-2	GD7-3						
						CV2-3	CV2-2	CV2-1			GD8-1	GD8-2	GD8-3						
					CV3-4	CV3-3	CV3-2	CV3-1			GD9-1	GD9-2	GD9-3	GD9-4					
CV4-9	CV4-8	CV4-7	CV4-6	CV4-5	CV4-4	CV4-3	CV4-2	CV4-1	CV		GD10-1	GD10-2	GD10-3	GD10-4	GD10-5	GD10-6			
						CV5-3	CV5-2	CV5-1			GD11-1	GD11-2	GD11-3	GD11-4	GD11-5				
		CV6-7	CV6-6	CV6-5	CV6-4	CV6-3	CV6-2	CV6-1			GD12-1	GD12-2	GD12-3	GD12-4	GD12-5	GD12-6			
				DA1-5	DA1-4	DA1-3	DA1-2	DA1-1			GS1-1	GS1-2	GS1-3	GS1-4					
				DA2-5	DA2-4	DA2-3	DA2-2	DA2-1			GS2-1	GS2-2	GS2-3	GS2-4	GS2-5				
			DA3-6	DA3-5	DA3-4	DA3-3	DA3-2	DA3-1			GS3-1	GS3-2	GS3-3						
					DA4-4	DA4-3	DA4-2	DA4-1	DA	GS	GS4-1	GS4-2	GS4-3						
					DA5-4	DA5-3	DA5-2	DA5-1			GS5-1	GS5-2	GS5-3	GS5-4					
					DA6-4	DA6-3	DA6-2	DA6-1			GS6-1	GS6-2							
					DA7-4	DA7-3	DA7-2	DA7-1			GS7-1	GS7-2	GS7-3	GS7-4					
							DM1-2	DM1-1			OI1-1	OI1-2	OI1-3	OI1-4	OI1-5				
					DM2-4	DM2-3	DM2-2	DM2-1			OI2-1	OI2-2	OI2-3	OI2-4	OI2-5	OI2-6			
	DM3-8	DM3-7	DM3-6	DM3-5	DM3-4	DM3-3	DM3-2	DM3-1	DM		OI3-1	OI3-2	OI3-3						
	DM4-8	DM4-7	DM4-6	DM4-5	DM4-4	DM4-3	DM4-2	DM4-1		OI	OI4-1	OI4-2	OI4-3	OI4-4					
						DM5-3	DM5-2	DM5-1			OI5-1	OI5-2	OI5-3	OI5-4	OI5-5	OI5-6	OI5-7	OI5-8	
											OI6-1	OI6-2	OI6-3	OI6-4	OI6-5	OI6-6			

The number of GIS UG course	
0	
1	

Rows showing the Knowledge Areas
Bold cells showing the Core Areas Units
Cells showing the Units

Table 5.15: Knowledge Areas and Units in the GI&T Body of Knowledge (BoK)
(adopted from Prager and Plewe 2009, pp.68-69)

Table has been removed due to Copyright restrictions.

5.3.2 Case study departments' facilities

Three main facilities are required to teach GIS properly: a lecture room which has enough seats and presentation tools (e.g. data projector.) (Plate 5.1); a dedicated computer lab which students should have the convenience of being able to use whenever they need to visit; and GIS software that allows students to undertake practical work. Obviously, all HEIs have standard lecture rooms which can be used for teaching the non-practical aspects of GIS (Plate 5.1), but the situation with labs and softwares can be more variable.

Plate 5.1: Lectures rooms used for Geography GIS options in two pre-1992 UK Universities

With the exception of CSD2 (which is in the pre-1992 sector), all of the CSDs have a computer lab within the department that allows for the teaching of GIS in formal classes and for students to use in their spare time. The size of the GIS labs varies from department to department, and the numbers of computers in the labs accommodate between 18 and 60 students (Plate 5.2). Hence, each practical session allows only from 18 to 60 students to attend the class. Exceptionally, CSD1 has a separate GIS lab for GIS Masters students, which has 25 computers. Moreover, CSD4 has a small study/project room for GIS UG students (with 5 computers). In addition, it should be acknowledged that a general lab can be turned into a GIS lab just by adding appropriate software. It is recognized as good practice that labs should be open-access as students might choose to visit the lab within their spare time for project work or for repeating structured exercises. It has been observed that all CSD departments offer this opportunity to their students.

Plate 5.2: Computer suites from a UK pre-1992 and a post-1992 University

However, a computer lab may nowadays be deemed rather less of a priority in that the CHEST Licence agreement (see section 3.3 in chapter 3) could allow all of the CSDs to give a free copy of ArcGIS software or Map Info software to students in the department with a small fee, generally for burning a CD/DVD. (This could have implications for the issue of student attendance.) Browne (1992) pointed out that there was a keen debate about the difficulties of teaching the Arc Info package to students (although it should be acknowledged that the software has since progressed to a very user-friendly level from what was a programming interface). In CSD1, the BA side prefer to use Map Info software for GIS modules, although the BSc side use ArcGIS. The main reason given is that the staff believe that Map Info is vector-based package software which is much easier to use and to teach the students for creating maps based on Vector data. Additionally, as for Masters and

UG GIS degrees, depending on the depth and breadth of the programme, they might need to use additional software packages (e.g. ERDAS) compared to Geography modules.

In addition to computer facilities, the CSDs have several data collections tools such as GPS, voice recorder, cameras and other laboratory facilities. CSD4 has also several items of surveying geodetic equipment such as Smart Rover and millimetric sensitive GPS.

There is also an important issue relating to the availability of support staff. Dawson and Unwin (1984) and Browne (1992) have underlined the importance of having technical staff committed to a Geography Department. It is interesting that only two Geography departments in our CSDs, both post-1992 universities, have a Cartography officer, and only one of these is “GIS-literate”. Departments are keen to have GIS technician support but in the view of the staff interviewed in CSD2 and CSD3, budget cuts in teaching resources are making this impossible or very difficult. For instance, before I visited the CSD2 department, a member of staff who used to be responsible for giving support to distance learning in GIS was made redundant. However, CSD6 still has its own technical support team with three people. This is, however, exceptional. Additionally, it has been seen that where there are Masters and GIS UG degrees, the technical support is not necessarily better. Overall, the technical support provision can be best described as highly variable but (given resources constraints) unlikely to improve.

A growth area in GIS teaching is Virtual Learning Environments (VLEs). As emphasised by Browne (2003), one of the advantages of having VLEs is allowing students to reach data and learning sources during the off-campus time. GIS is at the forefront of using VLEs in teaching, benefiting extensively from this facility, not least because application-driven modules require the use of digital data sets, data sources and documents and, keeping in contact with the lecturer.

Overall, in terms of equipment and infrastructure, the CSDs feel they basically have sufficient resources to deliver the provision of GIS education on a face-to-face basis (although lab size is a constraint on student numbers in one CSD). It should certainly be acknowledged that the level of technology in Geography departments is much better than the situation as described by Unwin and Dawson in 1981 and Dawson and Unwin in 1984. Increasingly, however, technical support is channelled through the central support units rather than the Geography department. This trend was noted in five of the CSDs, despite the fact that previous studies (Unwin and Dawson 1981, Dawson and Unwin 1984) have emphasised the benefits of “decentralisation” in providing a more bespoke and higher quality service.

5.4 Synopsis and Evaluation

The 2009 national survey undertaken for this thesis revealed a total of 70 HEIs where there was some kind of Geography-based GIS provision. This took one of three forms: 60 HEIs were identified where GIS was explicitly offered as part of an undergraduate degree in Geography (or some variant of it); in addition the survey identified seven HEIs where Geography was offering a full GIS undergraduate degree; and finally there were some 22 Geography-based GIS Masters.

With respect to the evolution of this provision, GIS first became part of UK University Geography teaching in the 1990s. It was initially pioneered at Masters level but later became an established part of Geography undergraduate provision. Although, in Geography degrees, GIS is commonly introduced at first year level, its presence here can be “hidden” by the fact that it is often simply part of a wider module dealing with skills and geographical techniques. At later stages GIS is typically taught as an optional module. Data from the six Case Study Departments (CSDs), however, indicate that GIS occupies only a very small proportion of the Geography curriculum. Moreover, because it mainly features as an option, most Geography students have only a very limited engagement with and therefore understanding of GIS. The GIS modules themselves have generally up-to-date curricula, basically aligned with the “GIS standard” known as the Body of Knowledge, but given that there is often only a single GIS module, the curriculum coverage, scope and student impact is inevitably modest. Moreover, the national survey revealed ten Geography degrees where there appeared to be no GIS teaching. For those who believe GIS should be an integral part of Geography degrees, this is a cause for concern.

The CSDs included 3 Masters and a full undergraduate course in GIS. Their curricula were, as expected, both broader and deeper. However, the GIS undergraduate course and one of the Masters courses are closing principally because of low and falling student recruitment. The impact of increased student fees and tighter visa restrictions on overseas students seems likely to intensify future recruitment problems at Masters level. Whereas recruitment to GIS options in Geography degrees is reasonably healthy, there are some concerns about contracting provision and falling student numbers on Masters and GIS undergraduate courses.

CHAPTER 6 : GIS PEDAGOGY IN THE UK: STAFF PERSPECTIVES

6.1 Introduction

This chapter focuses principally on staff's pedagogical approaches to GIS teaching both at UG and Masters Level. A set of research questions are identified in order to find out about GIS lecturers' approaches to module design, to the teaching, learning and assessment of GIS, alongside the wider usage of GIS in the UG Geography programmes. The data gathered from interviews with GIS lecturers and programme coordinators have been used to explore these issues. In addition to these primary data sources, some other resources such as module handbooks, programme specifications and classroom observations were also used to address the following research questions:

- What is the professional background of the GIS lecturers and how they become specialist in this field?
- How do they design their curricula? Do they, for example, use and benefit from the NCGIA core curriculum and/or the Body of Knowledge?
- What kinds of teaching methods do GIS lecturers most commonly use?
- To what extent do the ILOs align with Bloom's taxonomy and with the actual GIS teaching, learning and assessment activities?
- To what extent and in what ways do Geography GIS students have an opportunity to practise their GIS skills in other Geography modules such as the dissertation and field-work?
- How much do the staff engage in-service training (CPD) to improve their GIS teaching quality?

As set out in Table 6.1, seven GIS Geography lecturers (GISLs), plus four Programme coordinators (PCs) and three former GIS lecturers (FGISLs) were interviewed in order to address the questions above. However, it should be noted that two of the GISLs had double roles in that they were also responsible for coordinating a specialist GIS degree programme, one at UG level (CSD4) and the other at Masters level (CSD2). They were thus interviewed about questions relating to both UG and Masters level teaching. Additionally, one of the GIS programme coordinators was also formerly a GISL for UG GIS modules. Specifically, the former GISLs were also interviewed to explore questions which current GISLs could not answer because they related to original design/programme or the origins of GIS teaching in the department. The interviews schedule for GISLs and PCs were essentially the same. As shown in Table 6.1, the total number of interviewees was eleven all but one of whom was male.

Table 6.1: GIS staff interviewees in the UK CSDs

Case Study Departments	**Provision Features**	**GIS lecturers**	**Programme Coordinators**	**Former GIS lecturers**	**Total Interviewees**
CSD1	GIS Masters, Geography UG GIS Modules	GISL1, GISL2	PC1		3
CSD2	GIS Masters, Geography UG GIS Modules	**GISL3***	**PC2***	FGISL1[±]	2
CSD3	Geography UG GIS Modules	GISL4			1
CSD4	GIS UG Programme	**GISL5***	**PC3***		1
CSD5	GIS Masters, Geography UG GIS Modules	GISL6	**PC4***	**FGISL2***	2
CSD6	Geography UG GIS Modules	GISL7		FGISL3[±]	2
Total Interviewees		7	4	3	11

*The use of bold in the row cells indicates that these are same person, but with two roles.

[±]FGISL1 and 3 are retired academics while FGISL2 is still working in the department.

In the next sections of this chapter, the following subjects are dealt with in turn: the professional backgrounds of the Geography GISLs interviewed, the design of the GIS

Geography modules, the teaching, learning and assessment activities and the wider usage of GIS in the Geography programmes. In a later stage of this chapter, these issues are also discussed (more briefly) for GIS Masters and the UG GIS programme, highlighting any key differences between the Geography and specialist GIS programmes.

6.2 GIS Geography Lecturers and their Professional Backgrounds and Development

Regarding the backgrounds of the GISLs teaching on UG Geography programmes, five out of the seven identified their research backgrounds as being within the physical side of Geography, namely, Environmental Sciences, Landscape Ecology, Quaternary Sciences and Earth Sciences. The other two have academic backgrounds related to the social side of Geography, and particularly in Urban and Regional Planning. Although the sample is very small, there seems to be a tendency for GISLs to come from the physical sub-disciplines. This might point to the wide range of GIS applications in Physical Geography or to the fact that the department, for whatever reason, needed to make an appointment on the physical side to help with this area of teaching and/or research as well as with GIS.

Interestingly, all the GISLs identified themselves as GIS users rather than GIS specialists. As such, the idea of using GIS as a means of teaching Geography-oriented subjects seems to underpin the tool approach (see section 3.2). There academic philosophy is first and foremost that GIS is a tool used for solving Geographical problems. This philosophy may come from the fact that the GISLs typically became interested in GIS because they considered it useful for their special academic research. Although the GISLs came from different backgrounds, the most common attribute they share is their interest in using GIS as a part of their research and teaching.

However, given that none of the Geography staff are primarily GIS experts, staying abreast of recent GIS developments (particularly important when teaching a specialist GIS option) can be difficult. Although being at the interface between Geography and GIS can be advantageous in making it relevant to Geography students, having a foot in two camps can be demanding, as illustrated in the quote below from GISL7:

> It is quite challenging not being a GIS specialist but being a GIS user. I'm quite a distance away from the cutting edge of where GIS research is taking place and developments in GIS techniques and yet I have to try to keep up with both the GIS literature and with my main research field (GISL7, CSD6).

The length of the GISLs' experience in teaching GIS varied considerably from a minimum of two years to a maximum of twenty-five years, the average being twelve. Typically, therefore, the GIS staff were not short of directly relevant teaching experience. However, only one had GIS experience outside of Higher Education; he had previously spent fifteen years working for a surveying company. It is clear that the majority of GISLs in Geography programmes had no professional GIS experience outside of academia. In one sense this probably makes them little different from Geography academics as a whole. However, when delivering a vocational subject such as GIS, this absence of professional experience outside HE could be seen as problematic. This issue will also be referred to in chapter 8 (GIS and Employability in the UK).

When they were asked how they keep pace with developments in GIS, the results were that periodicals, textbooks, online networks and the web-pages of the main GIS vendors (e.g. ESRI website) are the most common ways of following developments in the GIS field. With respect to affiliation with a GIS organization, only two are involved in an organization or a research group devoted to GIS, namely the RGS-IBG GIScience Research Group and the Association of Geographic Information (AGI). However, by contrast, the majority are members of at least one research group/organization in the field related to their main research interest. This difference nicely illustrates the extent to which the GISLs saw GIS as occupying an integral but secondary position in their professional life.

This point is in a sense reinforced by the general primacy given to research rather than teaching across many parts of Higher Education (Healey 2005, Jenkins 2000, Jenkins et al. 2007). Putting more emphasis on research seems to be prevalent amongst most of the GISLs (even those in the former Polytechnics), because as discussed in section 2.2, the REF is one of the most important vehicles for assessing the performance of HEIs in the UK, leading many HE departments to see research as their main priority. The new White Paper (BIS 2011) does challenge the ascendancy of research over teaching but it will probably take some time to re-balance HE, especially in the older Universities.

Only one of the GISLs asserted that he has undertaken a small-scale pedagogic research project on GIS. Most are not actively involved in new developments in the field of GIS education, but they are actively involved in research and research organizations in their main field. By contrast, there was almost no contact with bodies supporting or encouraging GIS education (RGS/JGHE/SPLINT/JISC/GEES). The implications of this for their pedagogic approach are referred to in the following sections. Three of the GISLs noted that finding enough time is one of the main obstacles to keeping abreast of advances in GIS/GIS education. All believe that improving their GIS teaching skills is based on ‘‘the daily routine of teaching” (GISL3).

There was simply no time for engaging with the pedagogic literature (in GIS or other fields):

> I don't think I'm finding the time to keep up with new developments in teaching methods as much as I would like (GISL4, CSD3).
>
> I don't do anything like research on teaching, mainly because of heavy teaching commitments and management loads (GISL3, CSD2).

With reference to the GISLs' professional development in HE teaching and learning, those with more than ten-years teaching experience have no formal qualification. However, the younger GISLs have completed at least a one-year part-time certificate or diploma programme on teaching in Higher Education. One had also completed a PCGE programme for school teaching. The opportunity to apply for a lecturing position involving teaching GIS was the most important reason that they become involved in GIS teaching. In GIS, as in most other academic areas, the great majority of older staff have little or no formal training in teaching. However, this position has begun to change with HEIs now requiring newly appointed staff with little or no experience to take a part-time course in teaching and learning.

However, the generic pedagogic training provided by HEIs (Clark et al. 2002, Vajoczki et al. 2011) typically has only a small component, directed at individual disciplines, though staff are encouraged to draw on their own subject-based teaching when undertaking projects or assignments. Although the GEES SC successfully ran annual workshops for new lecturers in the GEES disciplines (Chalkley and Kneale 2011), this workshop programme did not specifically include work targeted at GIS teaching.

Recent work by Fagin and Wikle (2011) has found that the majority of their survey respondents comprising of GISLs in the US have had a formal training programme covering GIS subjects. By contrast, none of the GISLs in the CSDs stated that they have taken any formal training courses/workshops/certificate programmes on GIS. Indeed, two of them positively asserted that they learnt to utilize GIS by their own efforts. Overall, the results revealed that the GISLs typically first gained their GIS skills when they were post-graduate students needing to use GIS as part of their PhD research.

6.3 The Design of GIS Modules

Designing a module from the beginning might be a difficult task for lecturers with relatively little experience in this field. As explained in chapter 3, the NCGIA Core Curriculum and BoK could be useful resources for assisting with this process. However, it is also important to emphasise that module design consists of many other elements such as ILOs, teaching and learning activities, assessments, as well as the content of the module (Jenkins 1992).

Most of the GISLs had little or no experience of pedagogical issues when they were appointed to their lectureship, and so the department did not expect them to design (or re-design) a module straight away when they took on the position. Hence, three of the GISLs explained that their module contents and curricula had been inherited from another/previous member of staff. For instance:

> I have been lucky or unlucky! I'm teaching a module which had already been set up (GISL6, CSD5).
>
> I have inherited from my predecessor and the module specifications haven't changed (GISL7, CSD6).

However, four GISLs have created their own module contents based on their own ideas and experience. One of these is now the co-author of one of the best-selling textbooks on GIS:

> The design of the module is entirely my own (GISL4, CSD3).
>
> I went to it alone. I created my own materials based on my own research activities. A lot of what I teach I research about (GISL1, CSD1).

Interestingly, GISL5 and FGISL2 (who is a former lecturer in the module) stated that they made use of the NCGIA core curriculum, saying;

> We fitted it in as we could (GISL5, CSD4).
>
> The curriculum was based on the NCGIA core curriculum and on the personal experience of the academics in the course team (FGISL2, CSD5).

Additionally, FGISL3 indicated that he made use of some course notes available at that time in another HEI, namely Edinburgh University. However, there was generally very little evidence of this kind of dissemination or sharing of ideas between institutions.

In undertaking the process of curriculum design, only two GISLs had made use of guidance obtained from teaching and learning units in their University. The remaining GISLs did not involve their education/staff developers in any way. GISL1 indicated that he did not consider this necessary because:

> Every module goes through a departmental board for approval. There is a portfolio showing what the ILOs need to looks like (GISL1, CSD1).

However, one of the GISLs in a post-1992 University made clear that if a module was re-designed it had to proceed through the Teaching and Learning Unit of the University. This illustrates the arguably more rigorous QA systems (or simply perhaps more bureaucratic procedures!) which have tended to characterize the new Universities.

So, only a minority of the GISLs sought advice from teaching and learning specialists within the University and none had used external agencies such as the SPLINT CETL or the GEES SC (see section 3.1). Only one had been assisted by material from other HEI. This process of curriculum design appears typically therefore to have been conducted by a single individual (often the only GIS lecturer in the department) and with little or no involvement from either internal teaching and learning specialists or from GIS experts in other HEIs. However, it must be emphasised that this level of ‘isolation’ reflects the high level of autonomy characteristic of UK HEIs and is certainly not confined to GIS.

In the constructive alignment approach (see section 2.3), one of the first steps in analysing the components of the curriculum is to examine the learning outcomes (Biggs 1996). In order to achieve this, the entire ILOs of the full set of GIS modules have been examined with respect to Bloom’s taxonomy (Bloom et al. 1956). However, the first year modules featuring a little GIS teaching have been deliberately excluded because they are typically general skills/techniques modules with no separate ILOs identified for the GIS part of the curriculum. For example the following quote comes from a module handbook for a first techniques module:

> Search for and collect data and information from a variety of sources and systematically summarise, select, interpret and discuss the outcomes” (ILO in first year module covering ‘hidden’ GIS teaching in CSD4).
>
> Demonstrate appropriate techniques for collecting, handling and analysing data (ILO in first year module covering ‘hidden’ GIS teaching in CSD5).

In total, 46 ILOs (27 in mainstream[12] and 19 in subject-specific modules[13]) have been examined in order to find out where the action verbs of ILOs fit into the Cognitive Domain of Bloom’s taxonomy. As can be seen in Figure 6.1, the results revealed that more than half of the ILOs (56%) in mainstream GIS modules fall into the Comprehension and Knowledge levels; this is followed by the Application level with 26 percent. This shows that the majority of ILOs in mainstream GIS modules are addressing a low-order thinking level. Similarly, the Comprehension and Application levels are also dominant in the subject-specific GIS modules. High-order thinking

[12] Mainstream modules are particularly designed to deliver fundamental concepts of GIS and relevant practical exercises.

[13] Subject-specific modules have much stronger focus on the use of GIS in a particular field.

100

skills (Synthesis and Evaluation) were a small minority in both mainstream and subject-specific modules. Overall, given that the GIS modules are at 2nd and 3rd year undergraduate level, the ILOs appear to be pitched rather low. Moreover, there was no evidence of the third year ILOs being set up at a higher level than those in the second year.

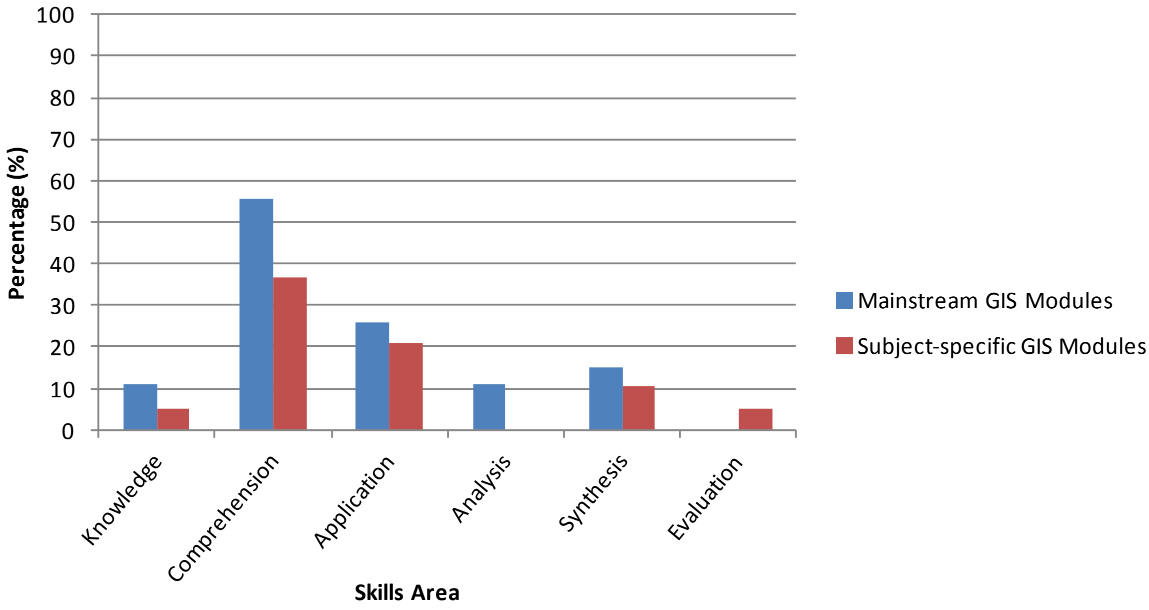


Figure 6.1: ILOs in the Geography GIS modules, with reference to Blooms' Taxonomy (by percentage)

6.4 Teaching and Learning, Activities

Publications on GIS teaching and learning have advocated that group-based learning, project-based learning, problem-based learning and field-work can be the most effective ways of facilitating students' learning (Wilder et al. 2003, Bednarz 2004, Drennon 2005, Carlson 2007); these kinds of methods can significantly enhance the students' GIS experience. As underlined in chapter 5, GIS is typically delivered on a semi-application basis that includes both theory lectures and practical sessions.

With respect to the theory parts of the curricula, the most frequently used approach is through the lecturing method in traditional, fixed furniture, lecture rooms; only, two GISLs preferred to deliver both GIS lectures and practical sessions within a computer suite. It should also be noted that my direct teaching observations indicated that GISL3 and 7 were unusual in that they integrated the *Socrates methods* (with an emphasis on question-answer) into their lecturing methods. Employing standard lecture methods in HE is sometimes criticized for leading students into passive roles and rote-learning (Gold et al. 1991). However, the GISLs nonetheless thought that this is an effective method of delivering GIS theory. This judgement might be related to the size of the cohort (see section 3.5), with groups often of thirty or more students leading academics to regard lectures as indispensible. With respect to the results of my direct classroom observations, four of the six theory classes observed were quite formal and the students seemed to be rather passive. Even when they were asked to raise any questions, generally there was no response.

In contrast, the practical sessions in UG Geography GIS modules were based mainly on student-centred, structured computing activities. The approach involves step-by-step instruction through “hands-on” activity sheets or a practical handbook. Interestingly, two GISLs follow a different approach to the delivery of practical activities, namely blended-learning. This approach involves the teaching of GIS using an online-system that is provided either by a GIS vendor, such as ESRI virtual campus (see Johnson and Boyd 2005) or by in-house products developed by local enthusiasts. These academics do not provide any practical handbooks or activity sheets for their students. Instead, the department provides students with a key which allows them to log on to the online system while they are still sitting in the computer suite; the lecturer and demonstrator(s) help students by responding to any questions or problems they may have. This approach might be useful, not least because, as Grundwald et al. (2007) and Zerger et al. (2002) emphasise, a multi-media or blended approach could be helpful particularly for those who learn most readily in this way. Although typically the first part of these practical exercises may seem to be close to 'spoon-feeding', the remaining parts normally allow students to engage in a GIS project based on real-world problems, usually on an individual basis. Overall, in the application part of GIS teaching, project-based and problem-based activities are quite widely used approaches. Almost all the CSDs provide this opportunity for their students. However, based on my teaching observations and on the module handbooks, it seemed that little or no use was made of group work.

From what I saw of the practical classes, students seemed to enjoy what they were doing and the interactivity was considerably higher than in lectures. In addition a number of practical classes also allowed students to interact with their peers. In these situations, some students tended to ask questions of their peers rather than directing them to the lecturer or demonstrator(s). The practicals therefore helped students to learn from each other.

With respect to the issue of why particular methods and/or activities were chosen by the GISLs, the most important factors given at interview were 'pedagogical thinking', 'limited time' and 'the variety of students' backgrounds.

The following quotes are broadly typical of the factors related to pedagogical thinking:

> I think that hands-on/PBL (Problem-based Learning) is a more effective way of learning, than delivering the module on the basis of lecturing, because I strongly believe that learning can be nurtured by an interactive and student-led session. This less formal approach helps their understanding of GIS, because they feel themselves free to ask questions in any part of these sessions (GISL6, CSD5).

> I use a website which has little video clips that show students how to move the cursor, to add a map, to zoom in/out, and scroll across, and use particular function sets for the coordinate system (GISL4, CSD3).

However, another of the factors affecting the GISLs' choice of methods is the constraint of limited time;

> I prefer to use problem-oriented teaching with a manual of the software, but I can't do that because I haven't got enough time (GISL1, CSD1).

As mentioned previously in this section, two of the GISLs made use of online ESRI virtual campus to deliver the main issues in GIS. They felt that this was an easy way of finding the right balance for delivering the content of a mainstream GIS module, alongside helping to cope with the variety of students' backgrounds:

> …my module has a variety of students coming from different study backgrounds (mainly BSc Geography, and BA Geography, but also a few from Archaeology and, Environmental Sciences). I believe that ESRI virtual campus is the best way to deliver basic GIS things to heterogeneous student groups (GISL3, CSD2).

Overall, therefore the GISLs chose lectures for delivering the theory aspects of GIS and student-centred learning activities when applying the theory in the computer environment. Although there was a considerable reliance on fairly conventional teaching methods, a few more innovative approaches were also introduced (e.g. blended learning). Potentially, one of the most effective methods for delivering GIS is fieldwork-based teaching, but none of the Geography GIS modules were being delivered in this way. This might be because of the numbers of students and the logistical and timetable difficulties which fieldwork can involve.

Although active student-led exercises typically comprise at least half of the contact hours, most of ILOs relate to the lower-level cognitive area in Bloom's Taxonomy, such as comprehension. The practical sessions could be used to enable students to develop higher orders skills such as evaluation and also to practise and strengthen transferable skills which again do not feature very prominently in the ILOs.

Problems and challenges

The GISLs interviewed identified several challenges and problems in delivering GIS within Geography programmes, relating, for example, to time constraints, student backgrounds and the computer laboratory sometimes being too small. The most common problem is that students do not have enough engagement with GIS to become really competent and confident.

So, the majority of students learn by simply following exercise instructions, but do not have the confidence or experience to solve a Geographical problem by using GIS. They are not able to take forward the process as autonomous learners, because they do not have deep knowledge or time for practice.

Another student-related problem is the diversity of their backgrounds. Among the CSDs, there is only one department offering separate GIS modules for their BSc students and BA students. As a result, GIS is normally being taken by a mix of students who have very different geographical interests and academic backgrounds. They come together simply to do their GIS. This issue is particularly echoed by GISL7 who had this to say when interviewed;

> I'm delivering my UG teaching to Geographers but Geography cohorts include Physical Geography students with particular interests in Hydrology and also Human Geographers interested in development studies. I also have a couple of engineering students who sit in on my classes. What this means is that I have to deliver GIS material in a very generic way.

Another issue dealing with students raised by GISL2 was the students' very varied levels of computer-literacy skills;

> The main issue is the level of students' computer skills; some are simply not technology-oriented (GISL2, CSD1).

Regarding challenges related to the wider Geography programme, GISL6 underlined that an issue for him is the design of the time-table, as there is a 9-month gap between the 2nd and 3rd year GIS modules. This makes difficulties for the students, because he believes that many of 3rd year students have already forgotten significant amounts of what they learnt in the second year.

Additionally, GISL2 on the BSc side of CSD1 asserts that GIS as a practical-based and computer-based module is somewhat different from other Geography modules, which makes GIS teaching rather isolated in the Geography programme. This also connects to the idea that ideally GIS should be more integrated into other parts of the Geography provision rather than being confined to only one or two modules. Interestingly, GISL4 in a pre-1992 University, asserted that the absence of a first year introductory GIS module or "taster" GIS teaching makes his job especially difficult because the content of the mainstream module needs to be "fast-tracked", this module having to be packed with basic GIS principles. In his words:

> ...some introductory work on GIS in the first year would be advantageous; we could hit the 2nd year with a bit more speed, if we had already covered some of these issues in the first year. It is also very time consuming for me because a lot of students book appointments with me for them talk about their problems and difficulties (GISL4, CSD3).

GISL6 also referred to a point relating to the broad nature of the Geography programme. He argues that because both the GIS lecturers in his department are Physical Geographers, the GIS teaching does not include enough exercises and themes for students mainly interested in Human Geography. It is clearly advantageous if the GIS module can achieve a balance which roughly aligns with the students' interests and preferences:

> I think social applications are probably an area that we need to address because we do miss issues such as crime and deprivation, but we can't cover them. Myself and the other GIS lecturer are both physical geographers (GISL6, CSD5).

In contrast to the student-related and programme-based challenges identified above, two GISLs (4 and 6) asserted that the capacity of the computer suite is an important challenge. For example, GISL4 indicated that, as a result of insufficient numbers of computers in the computer suite, he is forced to run repeat GIS practicals two or three times. In addition, GISL6 maintained that the capacity of the room does not allow him to take as many students as he would like. In this department, limited space/computing facilities regularly prevent some students from taking the GIS module.

> By far the most significant problem is the size of the room. If we had a bigger room, we could offer GIS to more people (GISL6, CSD5).

6.5 Assessment

A review of the module handbooks and the lecturer interviews showed that there is a variety of assessment methods being used by the GISLs. However, almost all the assessments are summative in purpose, with only one lecturer using assessment techniques for formative purposes (GISL5). With respect to assessment techniques, GISLs make substantial use of coursework (CW), the weighting of CW in the final mark of the GIS modules ranging from 30% to 100%.

With respect to the mainstream GIS modules, CW is again the most frequently used approach, particularly for the applications side of GIS. Nevertheless, three departments are still employing an unseen exam process to assess their students' learning outcomes. For example, the assessment strategy in the mainstream module in CSD1 and CSD6 is based largely on an unseen exam (60% and 70%, respectively). This is perhaps paradoxical for modules being delivered principally through practical exercises. As mentioned in chapter 5 (see section 5.3.2), the issue of attendance was raised as one of the main concerns by two GISLs, and they asserted that one of the important reasons for employing in-class tests or a paper-pencil exam is to increase the number of students attending the formal sessions. For instance;

> An unseen test offers a better chance of encouraging students to attend which is a big issue. Students are students, and frequently don't come to classes. But if they know there might be a test contributing to their final module mark, they are more likely to attend (GISL1, CSD1).

Students enrolled on the subject-specific GIS modules are usually assessed by CW exercises and /or a portfolio approach. Indeed no unseen exam or test was used to assess students in these modules, despite the fact that they include theory ideas and geographical concepts relating to GIS.

The relationship between ILOs, teaching and assessment was explored and Table 6.2 provides an example. Overall, the results indicate that there is often an inconsistency between the ILOs (which largely focus on lower level skills such as awareness and knowledge) and the way the students have been assessed. CW exercises and the portfolio approach often allow students to improve their high-order skills such as analysis, synthesis and evaluation, but this is rarely acknowledged in the ILOs. Overall, the alignment between the ILOs and the assessment methods is rather patchy and not sufficiently strong. This suggests not enough care was taken in writing the ILOs. It seems likely that some staff consider ILOs to be simply "paper-work" and merely than a bureaucratic requirement.

Table 6.2: An example of the relationship between Intended Learning Outcomes (ILOs) and assessment techniques in Geography GIS module

ILOs	T&L Activities	Assessment Techniques
-an understanding of key geographic and attribute information sources relevant to urban and regional planning sources and knowledge of how to extract data from them -an understanding of the development and application of GIS in public and private sector organizations engaged in spatial analysis and planning -an awareness of e-governance and local authority use of spatial data -an appreciation of the roles and adoption of proprietary and model-based GIS approaches in problem solving and planning -knowledge of the application of planning support systems in practice	11x2 hours lectures	50% Unseen Exam
-skills in data entry, manipulation, thematic mapping and spatial analysis using desktop GIS packages	6x1 hour practicals	50% CW (10 percent assessed practical+40 percent project task)

6.6 Wider Use of GIS

As indicated in the previous chapter, small amounts of GIS teaching can feature in other parts of the Geography programme such as modules in fieldwork, the dissertation and work-based learning. This section explores this wider use of GIS, based mainly on the information and views provided in the lecturer interviews.

Fieldwork teaching is an indispensable part of Geography provision in UK Universities (see section 2.4) and represents, potentially at least, a good opportunity for Geography students to practise their GIS skills. In particular, fieldwork is one of the most effective methods for teaching mobile GIS devices such as GPS, PDA etc. (Jarvis 2010, Jarvis et al. 2009). However, amongst the CSDs, only three lecturers (GISL2, 4 and 6) stated that some parts of the departments' residential fieldwork involved GIS activities, these being mainly for using GIS and geospatial data, rather than for teaching GIS principles. However, according to GIS staff, even this is limited to a very small proportion of total fieldwork teaching. As an example:

> I create a variety of maps and they pilot them on Google Earth. So there is a small amount of GIS used in the field-work teaching. However, this won't significantly increase students' GIS skills who haven't had any GIS background (GISL6, CSD5).

There are probably three obstacles to the wider use of GIS in fieldwork modules. One is that many students in fieldwork modules will not have a background in GIS. The second is that the same may apply to the staff leading the fieldwork. The third is the extra pressures created on the GIS facilities and staff.

Interestingly, GISL7 said that when he was involved in fieldwork teaching, it used to involve some GIS-oriented activities which he oversaw. However, when he left this role, the GIS dimension of the field course was abandoned because the other members of staff in the department did not feel comfortable teaching and using GIS. It was also interesting that in none of the CSDs was any GIS used in Human Geography fieldwork, which presumably reflects the fact that most of the GIS staff had Physical Geography backgrounds:

> On the BA side, we don't teach GIS in fieldwork, although in principle, we would like to include it. We recognize it has potential, such as mapping people's behaviour using GPS and that Mobile GIS is getting more important for the Human side (GISL1, CSD1).

As mentioned in section 2.4, the dissertation project is in many ways the most important part of UK Geography degree programmes and again offers potential for the use of GIS. However, the GISLs have noted that only a small proportion of students (those with a high degree of interest or background in GIS) tend to use it in their dissertation projects. Additionally, the number of students who are doing GIS-oriented dissertations can also be directly related to the quota of students that the GISLs have been allocated to supervise in the department. Nevertheless, a small number of students, normally having taken a GIS module, will decide to do a dissertation project principally focused on some aspect of GIS. In addition, other students may use GIS in their thesis but this is often simply to create maps rather than for undertaking more complex spatial analysis.

As discussed in the literature review (section 2.4), work-based learning can be another important opportunity for developing Geographers' employability skills, including GIS: practising it in a real work environment can be highly advantageous. However, the review of the Geography programmes found that only one out of the six CSDs has a work-based learning module. Within this department, some of the students enrolled on the GIS modules opt also for doing a work-based module as part of their UG study. Potentially this opportunity could be a valuable stepping stone towards obtaining a GIS job after graduation. However, in practice very few students combine the work-based learning and GIS modules.

> We have a stage 3 work-based module which allows student to go out into industry, so at the moment we have got 70 students doing the work-based learning module. Of those, I would say that there are normally only 4-5 GIS-oriented placements (GISL7, CSD6).

Overall, therefore, it is true to say that GIS is a rather isolated part of Geography programmes with the principal exception of a handful of dissertation projects. Given that there are relatively few parts of the discipline of Geography which could not or do not use GIS in some way or another, the general lack of adoption or interest across most parts of the subject appears disappointing.

6.7 Other GIS Provision: GIS Masters and the Full GIS Undergraduate Programmes

Having now provided an account of how GIS is taught and assessed in Geography undergraduate programmes, this last main part of the chapter turns attention to the Masters and full UG GIS programmes. Similar themes are pursued and once again the main sources used are the semi-structured interviews with staff (in this case programme coordinators), and the programme specifications and module handbooks.

6.7.1 Lecturer backgrounds

Compared with the Geography GIS modules, there are more lecturers involved in teaching on the GIS Masters programmes. This is because Masters level provision requires a broader and more substantial curriculum. In some cases, because of the need to deliver a specialised module, use is made of a “service” lecturer (e.g. from computer programming or web design). One CSD (CSD2) even employs lecturers from other universities. The nature of Masters programmes requires bringing together a mixed-background team of lecturers: this is in contrast to the reliance on a single staff member which tends to characterise Geography UG GIS provision.

The Masters GIS programme, CSD2, draws on a total of 18 staff. However, only eight are internal academics with the remainder being used only on an occasional/guest lecture basis from private companies (3) and other universities (7). CSD1 and CSD5 use considerably less staff (in total 7 and 9 respectively). However, the full UG GIS programme (CSD4) is supported by 10 members of staff, two of whom focus almost entirely on GIS teaching. In Geography departments which have both Geography and specialist GIS courses, the staff member responsible for leading the Geography GIS teaching also contributes to the GIS specialist course. This is considered to bring efficiencies and to help ensure, for example, a relatively smooth transition for any students wanting subsequently to progress from Geography to the local Masters course.

Overall, the staffing of the specialist GIS course was typically undertaken principally by academics, with some occasional “topping up” from work-based professionals either in the form of guest lectures or some assistance with the dissertations. As with the Geography UG provision, there was little evidence of using alumni.

6.7.2 Programme design

Two out of the three Masters programmes in the CSDs have been running for many years, although they have undergone a number of changes in recent times. For example, CSD2 has made really substantial changes both in the structure of the programme and in the content of the modules. They made use of the Body of Knowledge (BoK) refreshed the curriculum with contemporary GIS topics (such as computer programming for GIS, web-based and distributed GIS) and made the programme structure of the modules more flexible.

By contrast, the module curricula in CSD1, which is one of the oldest universities, appears not to have undergone major changes in recent years, except as a response to the downward trend in student recruitment, which has required the integration of previously different streams.

The last Masters programme, in a post-1992 institution, has quite a short history when compared to the other two. Its curriculum was designed with reference to the BoK and used also the staff's personal experience and industry survey. However, due to the student recruitment problems, this course may soon close.

The design of the specialist UG GIS programme had used similar sources and benefited in particular from one staff member having substantial GIS experience in the commercial world. However, it too now faces prospects of closure due to poor recruitment. It seems that despite the efforts put into curriculum design, recruitment problems are making life difficult for a number of the specialist courses.

Regarding the review of ILOs in the GIS degree programmes at Masters (CSD1 and 5) and UG level (CSD4), a similar approach was used to that employed earlier for the Geography provision. However, the lack of ILOs in the CSD2 Masters programme (at both programme and module level) was a major obstacle to conducting this analysis. The CSD2 has thus been excluded from this work. As seen in Figure 6.2, the distribution of module ILOs according to Bloom's taxonomy's has been graphed and shows that the Comprehension and Application areas are extensively addressed. However, the same is not true of the higher-order ILOs (with the single exception of evaluation in the CSD5 Masters).

These results are broadly similar to those from the Geography UG modules discussed earlier and make clear that generally the Masters provision is not using the higher-order ILOs which one might have expected at post-graduate level-a result which aligns with the research of Demers (2009). This finding together with the complete absence of ILOs in one of the Masters courses suggests that, although in principle ILOs are at the heart of the curriculum design process, in practice they are not receiving sufficient care and attention. It seems that members of staff are not well trained in writing ILOs and also that University course approval and quality assurance systems do not necessarily pick up and remedy any deficiencies and omissions. The quote below, illustrates the lack of priority sometimes given to ILOs:

> When I was designing my module, I didn't initially start thinking with the ILOs. I'm much more concerned about the issue of what data are available including some coming from my academic research (PC1, CSD1).

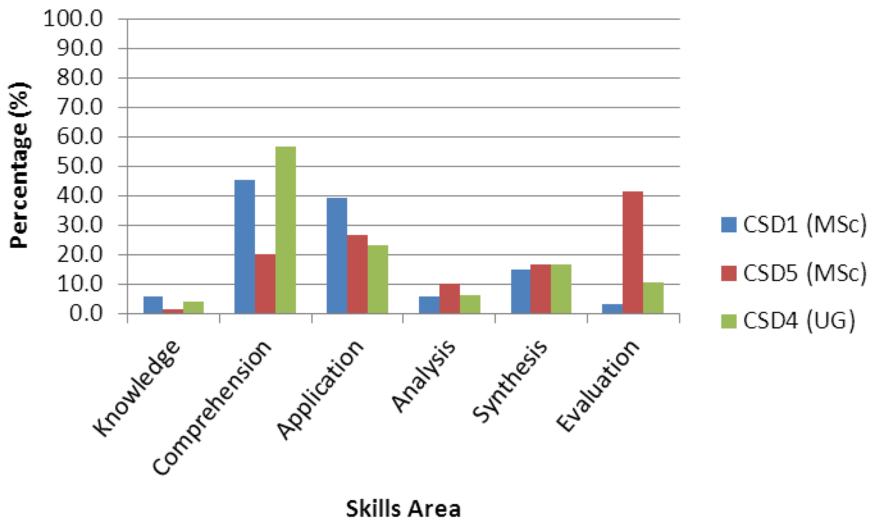


Figure 6.2: The ILOs in modules in UG and MSc GIS programmes (by percentage)

6.7.3 Teaching, learning and assessment

In discussing these areas the specialist GIS course PCs were often not confident in making comments about modules being delivered by other members of staff. For this reason, programme specifications and module handbooks are the principal sources used in this section. A review of these sources showed in the Masters programmes the expected pattern of using mainly lectures in theory sessions and directed computing exercises in the practicals. This mirrors the position in the UG Geography modules. In addition to these main teaching methods, there were also a few supplementary activities such as seminars, presentations and workshops (CSD1), blended learning (CSD5) and online discussion boards (CSD2). These are mostly methods that can be used in a classroom setting rather than in the field environment, but, exceptionally, a single module in CSD5 involves fieldwork-based teaching and some group learning activities. However, generally such techniques as fieldwork and group-based projects are largely absent from the Masters level teaching which essentially displayed a binary approach (lectures and directed-practical exercises).

Additionally, all the Masters degree programmes included a module involving a 'fast-track' or steep learning curve in order to bring all the students' GIS backgrounds up to a sufficient level to study a GIS MSc programme. While CSD2 and CSD5 employ blended learning approaches to deliver this module, the module in CSD1 was being delivered by a combination of lectures and computing exercises in laboratory settings.

Unlike the Masters programmes, the UG GIS programme gave much greater priority to learning activities being held in the field. Although the majority of teaching in the programme is still being delivered through lectures and associated practical sessions, seven modules involve either residential or a single-day fieldwork activity. The small size of the UG student cohort may well be a factor enabling more emphasis on field teaching (Carlson 2007). As a result, students in this programme have been provided with more direct experience of data collection and group-based learning activities. Interestingly, two of the modules include short-term (5 days/2 weeks) work-placements. Although lectures still comprise almost half of the teaching, the application-driven modules were generally delivered by a combination of laboratory and fieldwork approaches.

When making comparisons between the way modules are delivered in Masters programmes and the UG GIS programme, it is clear that the Masters programmes were much more directed at curriculum content, while the focus of the GIS UG programme was more on the process of developing broader transferable skills and the wider student experience, including data collection, team-working, communication skills, and real-work experience. This contrast may reflect the much greater availability of teaching time on the three year undergraduate course and the need for the single year Masters to pack in a lot of information very quickly.

With reference to assessment approaches in the Masters programmes summative assessment was dominant, although there were a few formative assignments in CSD5. In both CSD1 and CSD5, the assessment pattern is dominated by course work (CW) such as reports, essays and computer-based exercises. In the case of CSD2, however, there is a very different approach in that there is a fixed or standard assessment strategy for all of the modules in the department. All are based on summative assessment methods comprising an unseen examination (50% of the final mark), a short report on online discussion board (10%) and coursework (40%).

In CSD2, there is also the problem of the complete lack of ILOs in either the programme or module handbooks. In principle it is the standard HE model in the UK for assessments to be set which test how far students have achieved the ILOs, but the CSDs' Masters course is clearly not adopting this approach.

In contrast to the Masters programmes, the UG GIS programme has a more diverse set of assessment methods. Although the summative assessment approach is still dominant, a formative approach has also been widely adopted and used for teaching and learning purposes as well as for grading/assessment. One of the principles behind the assessment strategy is that the overwhelming majority of the modules should be assessed by more than two assessment techniques. However, although unseen examinations are still used in 6 out of 20 modules, their weighting in the final marking never exceeds 40 percent. The emphasis is on diversity and balance. It should also be noted that those modules which are assessed in part by examination are the geography-oriented optional modules rather than the application-oriented GIS modules. Overall, coursework of various kinds dominates the final marking.

6.7.4 Challenges and problems

Problems of student recruitment, also referred to earlier (section 5.3.2), were in many ways the main challenge and threat but with respect to teaching and learning the issues can be categorized under two headings; student-related and the nature of GIS teaching.

In the Masters programmes, all three PCs raised the issue that the students enrolling came from diverse disciplines and backgrounds. In particular there were comments about some students having weak IT skills. Another distinctive problem for the Masters courses related to the recruitment of overseas students who bring in high fees but whose standard of English can be weak:

> We get a few Far Eastern students whose technical and maths skills are good, but their English is not so good. English is also a problem for students coming from some Commonwealth countries (PC1, CSD1).
>
> Weak IT skills of some overseas students (mainly from Africa). Weak English language skills of some overseas students (mainly from Asia) (PC4, CSD5).

PC3 in the UG GIS programme considered the main challenge to be the demanding nature of GIS which combines both theoretical and practical aspects. Students who are good in one area may not be so strong in the other.

> GIS teaching is somewhat different from the other Geography modules, because GIS related modules include both GIS software teaching, use of the software and also GIS theory (PC3, CSD4).

6.8 Synopsis and Evaluation

The chapter has reviewed the three types of GIS provision, namely modules within undergraduate Geography, GIS as a full undergraduate course and GIS Masters courses. In all these settings, the perspective taken in this chapter has been that of the teaching staff; we have seen the GIS provision principally through their eyes, and through their programme and module documents.

In the case of the Geography programmes, the GIS lecturers are typically physical Geography academics rather than staff who consider themselves first and foremost as GIS specialists. Nonetheless, they had clearly enjoyed high levels of autonomy in preparing the GIS curricula. Although a few had used the BoK and NCGIA Core Curriculum as a source of guidance, there had typically been little or no contact with GIS companies, expert staff in other HEIs, former graduates working in GIS posts or specialists in HE pedagogy (either generic or subject-specific). Such circumstances are, however, not in any sense unique to GIS but reflect the high levels of individual responsibility generally accorded to UK academics. Certainly, the evidence of this survey of HE practice in GIS indicates that very little use of is made of the either internal pedagogic experts or of external GIS specialists in the process of curriculum design or indeed delivery. Given that most of the Geography staff were not primarily GIS specialists, a harsh critic might find this worrying. However, in practice the curriculum coverage seemed appropriate, though the teaching and the module documents were not above criticism.

It has been seen, for example, that insufficient care and commitment were devoted to writing ILOs which are often thought a vital part of module design. Similarly, the relationship between ILOs and teaching and assessment methods needed more careful attention. The institutions' Quality Assurance procedures are expected to pick up on any weaknesses or anomalies in these areas but had not always done so.

The main GIS teaching is typically delivered by lectures covering the theory and practical exercises dealing with applications. The lectures I observed were conscientiously prepared and planned but could be criticised for providing only a rather passive learning experience. The practicals were more student-centred and interactive, with students better able to discuss and learn from each other. With respect to assessments, theory is often examined by a formal unseen examination and the practical dimension by coursework assignments, which are sometimes gathered together in a portfolio format. One of the most important roles of assessment is to enhance the students' learning (Boud 2007). However, in the UG Geography GIS modules, there was very little evidence of assessments being designed primarily for a formative (educational) role. The emphasis was strongly on summative assessment for grading purposes.

Within Geography UG programmes, there appears to be relatively little GIS work which spreads outside the GIS modules and extends more widely across the curriculum. Many Geography students will therefore have little or no contact with GIS and its capabilities. This might also indicate that 'teaching with GIS' occurs only rarely. A stern critic might say that despite its wide potential, GIS is in some danger of living in an "academic ghetto".

Although the younger staff have normally completed a course in HE pedagogy, there was little evidence of the GIS academics connecting with the relevant national centres of guidance in HE pedagogy, such as the SPLINT CETL or the GEES Subject Centre. The staff's general lack of contact and engagement with experts in pedagogy may reduce innovation in teaching and assessment methods. It is principally the result of staff having many other commitments and of reward systems which do not sufficiently encourage teaching innovation and excellence. Certainly CPD for teaching did not seem to be a staff priority.

Much of the above description also applies in the case of the GIS Masters and full undergraduate provision. One difference, however, was the wider use of staff from outside the host department, for example from the institution's computing department and in one case from another HEI. This broader range of staff were needed to cover the subject curricula which are obviously wider and deeper than for a single GIS module within a Geography degree. The additional staff resources did not, however, produce closer contact with pedagogic expertise, as illustrated again by uncertainties about the appropriateness or complete absence of some ILOs. Masters' staff comments included the difficulties of teaching a technical subject to overseas students with sometimes only a modest command of English. In the case of the UG GIS degree there were again comments about the constant tension between theory and practice. Despite these concerns and anxieties, all the staff interviewed in all three categories of GIS provision were positive, enthusiastic and clearly had a genuine belief in the value and importance of GIS teaching, even though for many GIS was not their only or indeed their principal area of teaching or research.

CHAPTER 7 : GIS PEDAGOGY IN THE UK: STUDENTS' PERSPECTIVES

7.1 Introduction

Having considered a number of GIS education issues from the staff perspective in the previous chapter, the main focus in this chapter is on the students' experience of GIS. First there is a review of GIS modules in UG Geography programmes (section 7.2) and then the subsequent section reviews similar issues from the perspective of the specialist GIS degree programmes' students, both undergraduate (UG) and Masters (section 7.3). The main focus of the discussion is on teaching and learning but the questionnaire (see Appendices 2, 3 and 4) also touches on other issues such as why students chose to study GIS. The chapter ends with a brief summary of the main findings (section 7.4).

In order to address the kinds of research questions listed below, students' questionnaires collected from the Case Study Departments (CSDs) have been analysed using both quantitative and qualitative techniques. In the quantitative data analysis process, some basic statistical methods (such as percentages and frequency distributions) have been employed, together with two more advanced statistical tests, namely ordinal regression analysis and Spearman's rank correlation coefficient. More detail on this has been included in chapter 4 on research methods. With respect to the qualitative data which came from the students' questionnaires, in order to analyse the answers given to open-ended questions about pedagogic issues, a thematic technique built on content analysis was adopted (see section 4.5.4).

The kinds of questions examined in this chapter are as follows:

- Are GIS module students aware of GIS education before coming to study Geography at university?
- Is the employability potential of GIS a reason given by students for choosing a GIS module or full degree programme?
- To what extent were expectations of Geography students enrolling on GIS modules met?
- To what extent are students satisfied with the teaching and learning process which they experience in GIS module(s)/programmes?
- What are the most valuable and the least valuable parts of GIS teaching based on students' views?
- To what extent and in what ways do GIS students have an opportunity to practise and apply their GIS skills in other Geography modules?
- To what extent and in what ways do GIS module (s) differ from other Geography degree modules in terms of their teaching and learning activities?
- What does the questionnaire survey tell us about the differences between the pedagogy and the student experience and satisfaction in the three kind of GIS provision?

7.2 The Geography Students' Experience of Geography-based GIS Modules

This section addresses a number of the questions raised above through a review of the data obtained from the Geography students who completed the questionnaire. It begins with a brief discussion of the key characteristics of the students taking the GIS modules.

7.2.1 Geography GIS students' characteristics

Here a profile is presented of students enrolled in GIS modules in Geography and also the reasons why they chose to study a GIS module. As can be seen in Table 7.1, 175 student questionnaires from five case study departments (CSDs) have been analysed. It should be noted that the numbers of completed questionnaires vary amongst the CSDs (see section 4.5.2 in Chapter 4 and Table 4.2). This variation primarily reflected the number of students in the sessions where the survey was administrated.

The analysis of participant students' gender showed that the number of female students (55%) was slightly higher than the number of males (45%) (Table 7.1). However, these proportions basically reflect the overall national HE figure of 54 % female and 46% male students (Higher Education Statistics Agency (HESA 2011). Moreover, the GIS staff were asked informally about the gender balance, which they confirmed as broadly reflecting the overall figures in their departments. There is no evidence here therefore to suggest that more male/female students are inclined to choose GIS modules or that there is a gender bias amongst those responding/not responding to the questionnaire survey.

Table 7.1: The main characteristics of UK survey participants: Geography students

Students' demographic features		
Demographic attributes	**Number**	**(%) Percentage**
Gender		
Female	96	55
Male	79	45
Total	175	100
Age Group		
18-25	155	89
26-33	13	8
34+	6	3
Total	174	100
Level		
2	107	61
3	62	35
4	6	3
Total	175	100
Programme Name		
BSc Geography	80	46
BA Geography	54	31
Combined BSc (Major)	9	5
Combined BA (Major)	15	9
Other	16	9
Total	175	100

The vast majority of survey respondents are in the 18-25 age bracket (89%); this group is followed by 26-33 (8%) and 34+ (3%). This distribution basically mirrors that for the discipline as a whole. Some 46% of students were enrolled on BSc Geography, while 31 percent were registered on a BA Geography programme. The third biggest group (24%) includes the students doing combined BSc degrees (e.g. BSc Geography with Geology) and combined BA degrees (e.g. BA Geography with Planning). Additionally, there is a minority group (9%) identified as "others" whose degree programme was outside Geography and in fields such as Engineering or Archaeology. Some 60 percent of students were studying at second year level, whilst 40 percent were in their third year. In particular, as can be seen in Table 7.1, there is a small number of students in their 4th year (these are mainly part-timers in the 34+ age group).

Students were asked whether GIS had played a role in their decision to study Geography at university. Trend (2009) identified four main factors in his research seeking the reasons for choosing Geography, one of most important, not surprisingly, being an interest in the discipline's subject matter. In our study, the vast majority of respondents (85%) stated that GIS did not play any part in their choosing Geography. This was followed by the students who answered 'Not sure' (9%). However, a very small minority (6%) of students said that although GIS was not the major factor affecting their choice, it did contribute to their choice. For instance:

> Because I knew GIS students had good employability, it reinforced my decision (GUG104, CSD1).
>
> It was something that interested me, alongside everything else geography offered (GUG84, CSD1).

It is interesting to note that a report on the Geography National Curriculum for secondary Key Stage 3 (school years 7-9) in 2000 recommended incorporation of GIS (Mitchell 2010) and similarly into GCSE/A Level in 2010 (Walker 2010). Nevertheless, only two students underlined that they had some GIS experience at school before coming to University. The reasons for this apparent near absence of GIS at pre-HE level are not entirely clear and have not been researched elsewhere in the GIS literature. However, two possible explanations can be put forward in relation to this PhD research: one is that these curricula changes had not been put into effect when the survey respondents were still at school and the second is that a lack of teacher expertise in this specialist field may be the main obstacle (interestingly RGS-IBG is now offering a GIS training programme for school teachers). However, students may have been exposed to some aspects of GIS within their school curricula without realising they were using Geospatial tools (e.g. Google Mapping and Google Earth).

With respect to the factors affecting students' decision to choose a GIS module, five major themes made up 96 percent of the answers. In order of frequency, they were: careers/employability, academic reasons, subject interest, prior experience in an earlier stage of the course, and better than the other optional modules. The most common reason given (34%) was employability. For example:

> GIS is relevant and important if I want to be an urban planner (GUG1, CSD6).

The second most frequently given factor was the appeal of the subject matter. Some 22 percent of students felt that GIS seemed to them to be an interesting and useful (attractive) subject.

> I thought the module would be interesting (GUG11, CSD6).

Academic purposes (19%) was another important factor, students thinking that GIS might be useful in other parts of their geography course such as the dissertation or other modules involving mapping or spatial analysis.

> I wanted to build up as many geographical skills as possible and thought I may need it for my dissertation next year (GUG111, CSD1).

The fourth reason they gave (11%) was that they enjoyed their previous experience, normally in the first year GIS teaching:

> I enjoyed the taster GIS in the first year (GUG27, CSD6).

The last reason was simply that GIS was considered a better option than the others available (10%):

> We had to choose one of the two research modules and I didn't want to do the statistics module (GUG115, CSD1).

Overall, the perceived employability benefits of GIS and its potential usage in other parts of the degree seemed to be the main factors behind students' motivation to take a GIS module. The first year "taster" teaching in GIS played only a very minor role: it had only really enthused a small minority even amongst those students who went on to take a GIS module.

7.2.2 Teaching and learning activities

This part deals with the students' experience of teaching and learning activities in Geography GIS modules (Section 2a in the questionnaire sheet). As can be seen in Figure 7.1, the most frequently used teaching and learning activity was directed computer exercises (Figure 7.1: activity 3), while the least used activity was the work-based learning activities (Figure 7.1: activity 12), indicating the lack of a placement experience or work-based learning as part of the GIS modules (which would have been very difficult to accommodate in the time available and to arrange for large student numbers). Within each CSD there was a high level of consistency in the students' impression of the relative frequency of the different forms of teaching.

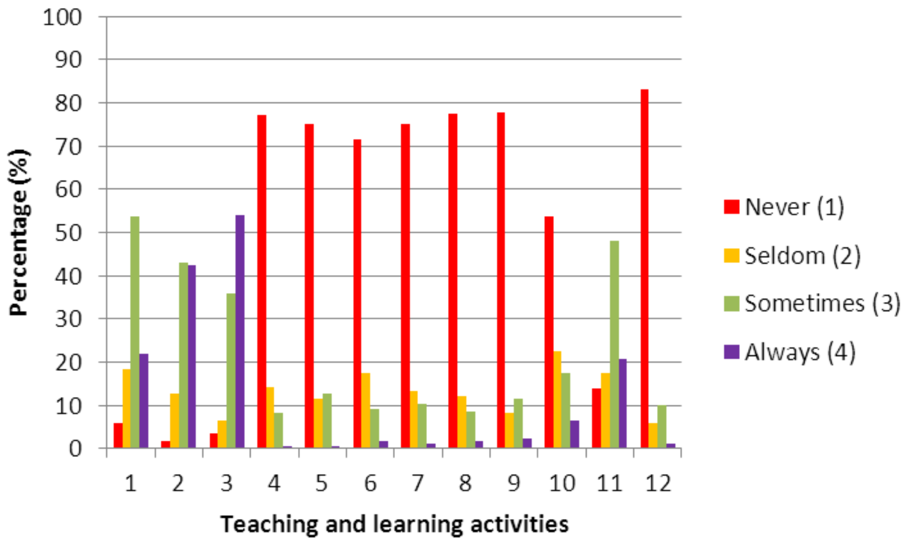


Figure 7.1: Frequency distribution (%) of respondents' answers on the amount of use made of various teaching and learning activities *(**Key:** 1. GIS project planning tasks.; 2. Undertaking a GIS project (s).; 3. Structured GIS activities in a computing suite.; 4. Mobile GIS using activities by handling Notebook or PDA.; 5. Data collection activities by using compass or other analogue survey methods in the field.; 6. Data collection activities using GPS in the field.;7. GIS using activities in the field. ;8. Orienteering activities in the field using GPS, GIS or maps.;9. Primary data collection activities e.g. interviews or questionnaires.; 10. Presenting results of GIS activities (either oral or poster presentations).; 11. Secondary data collection activities in the field or online.; 12. Work-placement learning activities in a real working environment)*

A number of statistical hypotheses have been tested relating to the reported frequency of different types of teaching and learning activities:

H_0= There is no significant difference amongst students' answers either between gender categories, between year groups, or between the CSDs to which they belonged.

H_1=There is a significant difference amongst students' answers depending on their gender, their year groups, or the CSD to which they belonged.

In examining the above hypotheses and the data used to produce Figure 7.1, an ordinal regression analysis was undertaken across the full student questionnaire data set. Perhaps not surprisingly, this revealed no significant differences by gender (not significant at 0.01 level). However, there were significant differences between CSD1 and the other CSDs with respect to activity 2 (undertaking a GIS project). For example, students in CSD1 were 1.6 times more likely to experience a project than their fellow students in the department which was the least committed to GIS project work. The high score for CSD1 derives from the particular enthusiasm of the member of GIS staff who during his personal interview expressed very clearly his commitment to this form of teaching. In addition, the analysis revealed a significant relationship between 2nd year students and activity 2 (significant at p 0.01 level). The reasons behind the fact that 2nd year students reported a higher frequency of project work than 3rd years are not entirely clear. This is perhaps partly because the differences between the 2nd and 3rd year results are relatively modest (a multiple of 1.2). However, perhaps the explanation may be related to the fact that most of the final year GIS modules were linked to particular subject areas (e.g. environmental management) and so the staff used more lecturing rather than projects to convey the necessary knowledge and information about that subject field.

A high proportion of students referred to practical exercises as the most valuable part of GIS teaching (see Figure 7.2) (a theme which was referred to also in the literature review in section 3.5). This result was also in line with that of Lloyd (2001). Some students also offered an explanation as to why practicals were particularly useful, often using the phrase; "putting the theory into practice" (GUG5, CSD6). Additionally, students recognized the value of active participation in the teaching and learning process:

> Practicals, which make the module more interactive, give a chance to get involved with what is discussed in lectures (GUG12, CSD6).

The students also highlighted the value of practical exercises in underpinning subsequent project work:

> Having the practical sessions before the project was useful, because we had some insight into the programme (GUG32, CSD3).

This quote emphasises the importance of the teaching sequence, moving from staff-directed activities to those which are more student-centred and self-paced. This confirms also the work of Solem (2001) and Fraser (2005) who have emphasised that students need a good understanding of the software before being asked to apply it in a project. Students clearly recognized the benefits to this sequenced approach, and in particular the benefits of the hands-on experience offered in practicals. My own classroom observations confirmed the high level of student engagement and motivation in the practicals. The students also enjoyed the less formal atmosphere and the chance to ask questions from the academic staff, from the demonstrators and from each other.

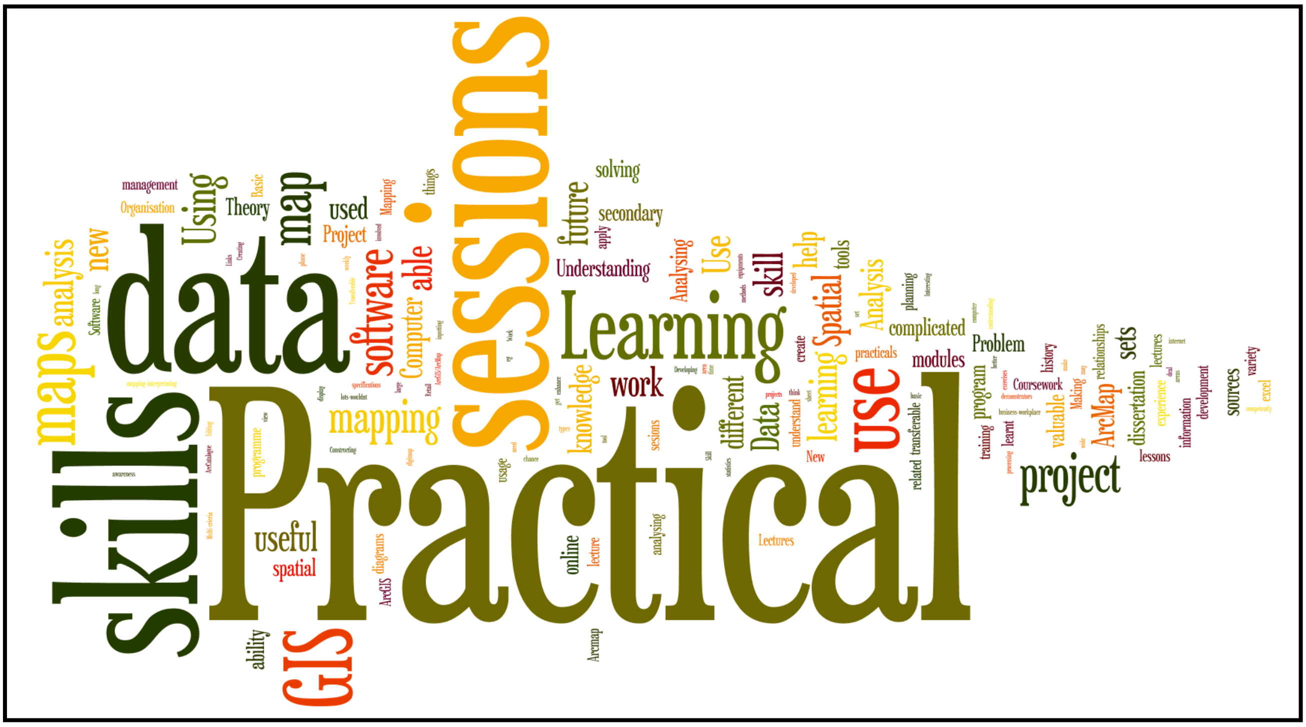


Figure 7.2: Tag cloud of students' opinions on the most valuable part of GIS teaching

On the other hand, the review of comments on the perceived least valuable parts of GIS teaching revealed the lack of value attached to lectures (Figure 7.3). Some aspects of this issue have already been commented on in the literature review (section 3.5) and through the researcher's direct classroom observations in the previous chapter. Students felt that lectures were not of benefit because they were not interactive and certainly those I observed well structured but rather passive experience. This relates to the question of how GIS should be taught, and in particular the tension in the 'Education versus Training' debate (Unwin 1991, Forer and Unwin 1999). It is interesting that the lecturers strongly believe that the theoretical sessions are an essential part of GIS teaching. They give weight to the education side rather than simply training people for using industry-standard software. However, the students tend to think that GIS theory or background is not so valuable and wish to have more practical sessions instead. This finding was also in line with that of Whyatt et al. (2011). Additionally, some students maintained that they really did not know how they will use this theoretical background in their future careers. It seemed disconnected from employability and the world of work. By contrast, the academics considered theory lectures as essential for employability because individual software packages can soon go out of date.

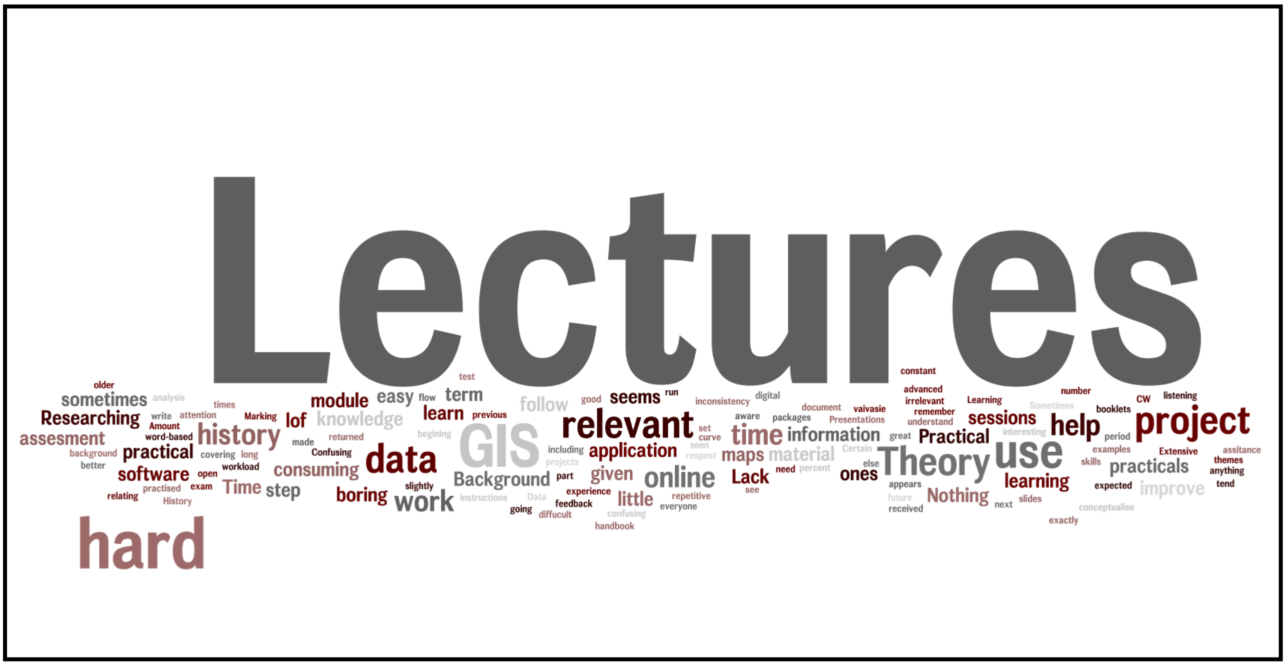


Figure 7.3: Tag cloud of students' opinions on the least valuable part of GIS teaching

Specifically, some students could not see the value of studying topics such as the history of GIS or more generally of maps and cartography. The following are examples of student opinions on the GIS lectures:

> The first two lectures were irrelevant. I would rather have had two more practical sessions (GUG58, CSD3).
>
> Lectures; sometimes confusing and not easy to follow (GUG83, CSD1).
>
> Lectures; hard to grasp concepts from just listening (GUG10, CSD6).
>
> The lectures are boring (GUG117, CSD1).
>
> Lectures material could be more interesting (GUG142, CSD1).

7.2.3 Assessment

In the GIS modules the main assessment components are CW (and variants) and the unseen exam (see section 2.3.2). In survey question 4a, students were asked to state how far the assessment process helped them to improve their GIS skills and to grasp GIS issues (see Appendix 2). They were first requested to generate responses using a 5-point Likert scale (1=not at all; 5=a great deal) and then to provide a brief explanation for their choice. A large majority of respondents (over 65 percent) opted for numbers 4 and 5, the 'much' and 'a great deal' categories (see Figure 7.4). The generally favourable view of the role of assessment in learning could derive in part from the importance of coursework exercises involving a substantial practical or project dimension. This kind of experiential (learning by doing) approach provides deep learning. It was interesting that students did not appear to notice or complain about the lack of formative assessment.

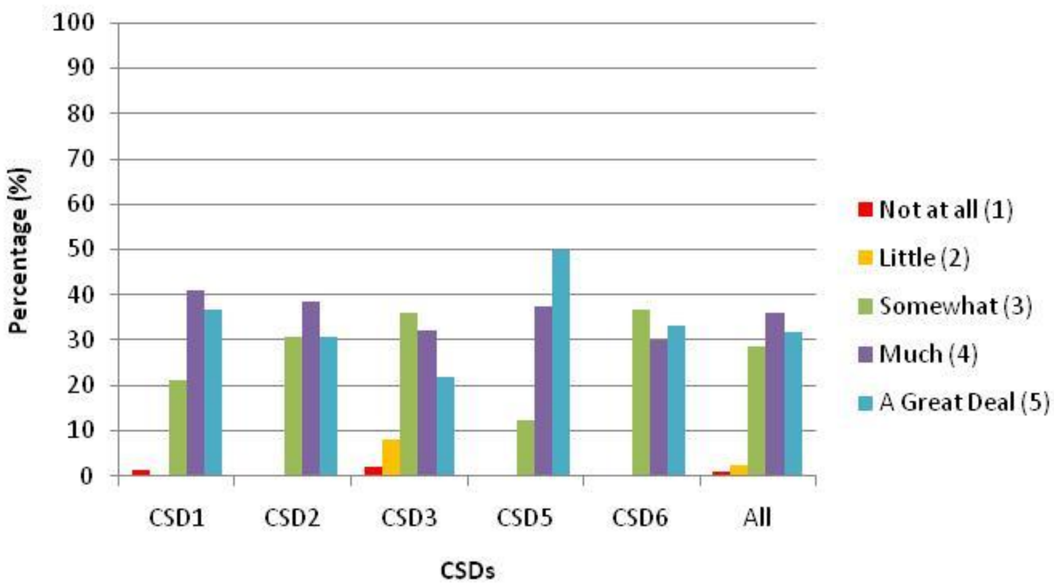


Figure 7.4: Students' opinions on the value of the assessment process for their GIS learning

The relationship between the survey answers on the value of assessment and students' gender, year of study, and case study department were investigated using an ordinal regression test and there was no significant difference found at the p=0.01 level.

However, the use of the Spearman's rank correlation test revealed three factors which had positive relationships with students' reporting a strong appreciation of the contribution of assessment to learning. The first two were students' reporting high overall satisfaction levels with their GIS modules ($r=0.36$, $p<0.01$) and students reporting high levels to which the modules had met their expectations ($r=0.39$ $p<0.01$). (Issues surrounding satisfaction and expectation are discussed in more detail in section 7.2.4.) It seems that students' feelings about assessment are closely related to their overall views on the quality of the GIS module. However, as is sometimes the case with correlations, it is difficult to disentangle "cause and effect". It may be that a generally favourable view of the module simply inclined the students' to report favourably on assessment too. Or it may be that assessment is seen as such a key part of the module that it plays an important role in influencing students' overall module views. (In practice, of course, both processes might be at work.) The third pattern identified through the Spearman's rank test was a relatively low but still significant correlation between students' valuing the contribution of assessment to learning and their having frequently being engaged in GIS project-based activities ($r=0.27$, $p<0.01$). This links to the fact that students really liked the project work and also preferred coursework, often related to projects, rather than formal unseen examinations.

When looking at the reasons students gave for their views on assessment, where they answered with numerals 4 and 5, the following comments were typical:

> Coursework helped lots with familiarity with ArcGIS (GUG8, CSD6).
>
> Made me do my project myself so I had to use the knowledge I had learned in previous GIS practicals in order to do the project (GUG58, CSD3).

Only, one of the respondents mentioned the value of formative assessment techniques:

> Assessments required theoretical understanding and practical use of GIS. But equally valuable were the unassessed practicals (GUG170, CSD5).

However, there were still a small number of students who do not think that the assessment methods helped their learning and understanding. Although the reasons for this are not really clear, the following quotes are perhaps relevant:

> Not enough time to do the assessed project, so it is very hard (GUG36, CSD3).
>
> No other assessments have used GIS (GUG119, CSD1).

As indicated by the GIS lecturers in chapter 6, some negative comments on assessment are to be expected, perhaps particularly from students with little commitment or a lack of interest in the subject and from individuals struggling to meet the module requirements and its assessment processes. However, one of the students stated that exam-based and essay assessment does not help to facilitate their learning and specially 'deep learning' (see section 2.3);

> I prefer to learn by doing rather than learning theories and ideas (GUG24, CSD6).

Several students (29%) felt that assessments have been only "somewhat" helpful and their understanding of GIS was still not strong:

> I have learnt from the assessment exercises; however I feel I don't know GIS thoroughly (GUG42, CSD3).
>
> I understand a lot more than I did but I still wouldn't say I have a good grasp of GIS (GUG115, CSD1).
>
> I understand the concept at the time of learning, but I've forgotten most skills as they are not widely used (GUG76, CSD3).

In addition, some students underlined the issue of feedback as a weakness in the continuous assessment process:

> Feedback on assessment is sometimes delayed and comments can be too general (GUG120, CSD1).

This issue of feedback is often a problematic area in the UK's National Students Survey (NSS) (see section 2.4) and affects a wide range of programmes in many HEIs. This is therefore a wider issue than GIS in the CSDs and relates partly to the difficulties staff face in finding the time to return work quickly and with helpful comments.

In the same critical way, a few students complained that unseen or test-based assessment seemed irrelevant or even pointless. This connects with the discussion in the previous chapter about a possible lack of alignment between lecturers' assessment methods (and weightings) and the modules' ILOs. The purpose and value of unseen exams in particular was not clear to some students, though this scepticism may relate to the students' poor opinion of the lectures, whose material is most often tested by unseen exams.

In evaluating the assessment arrangements, not a single student referred to how well they tested the modules' ILOs. Although in principle ILOs are at the heart of the learning and assessment process; in practice they did not seem to play any part in the students' thinking.

7.2.4 Students' expectations and satisfaction levels

Students were requested to show how far the GIS module met their expectations via a 5-point Likert scale (1=highly dissatisfied, 5=highly satisfied) and similarly with their level of overall module satisfaction (1=to a very small extent, 5=to a very great extent). In addition, questions were asked about the reasons behind their answers.

With respect to students' expectations, as can be seen in Figure 7.5, over 50 percent answered the question with numbers 4 and 5 (48% and 6%, respectively). This was followed by the numeral 3 which is the mid-point of the scale (37%). The remaining categories, namely 1 and 2, were picked up by only a small number of students together (9%). Clearly, the overwhelming majority of students felt that, basically, the GIS module lived up to expectations. . In this respect, ordinal regression analysis showed that there were no significant differences by either gender, year of study, or by CSD (none being significant at the p=0.01).

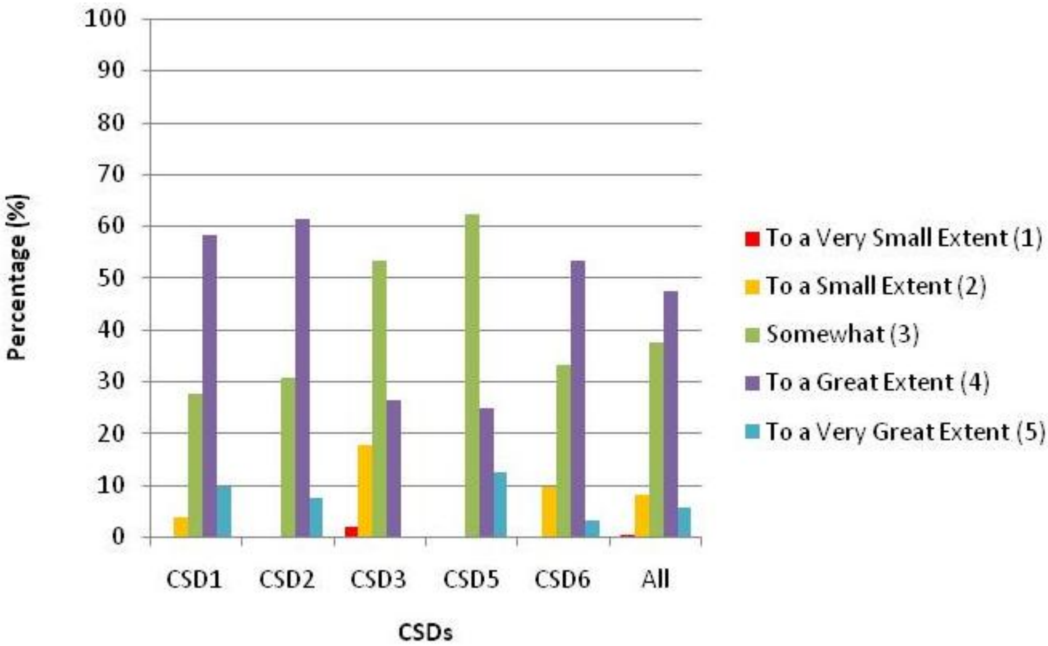


Figure 7.5: Students' answers as to how far their expectations of their GIS module were met

The following quotes illustrate the reasons students gave for their expectations being met or exceeded:

> I expected the module to be like it has been as I researched the area before selecting it (GUG12, CSD6).
>
> Although hard at times, it has been enjoyable as expected (GUG85, CSD1).

However, where the students felt that GIS teaching did not live up to expectations, the reasons typically related to insufficient practical work:

> Thought it would be more practical-based than lecture-based (GUG138, CSD1).

Some students also underlined the lack of embedded direct data collection activities in the teaching and learning process.

> I would like to do more field-based work (GUG128, CSD1).
>
> I wanted to learn more practical skills and collect spatial data instead of just analysing secondary data (GUG5, CSD6).

The CSD3 module is not underpinned by "taster" GIS teaching in year one. It may be for this reason that only 25% of its students felt that the module had met their expectations to a great or very great extent. Their expectations were not based on the actual experience of GIS teaching.

With respect to students' overall satisfaction with their GIS modules, the vast majority (77%) rated the modules at numeral 4 and 5 indicating that they were 'satisfied' or 'highly satisfied'. The dissatisfied and highly dissatisfied categories were in total nominated by only 6 percent of students. Additionally, 18 percent of students were neutral (neither satisfied nor dissatisfied). As can be seen in Figure 7.6, the percentages showed some variation between the CSDs, but the overall pattern was fairly consistent. Additionally, the non-geography students' views (81% satisfied/highly satisfied) also followed the general trend which was revealed from Geography students, as shown in this quote:

> I'm very much enjoyed it, the online course and the classroom work too (GUG167, CSD2).

In exploring student satisfaction levels, a model including the variables gender, year of study and CSD was run by ordinal regression analysis. Although no significant differences were found in students' opinions which related to their gender or year of study (neither being significant at the p=0.01), it was found that students in CSD3 were generally less satisfied than those in other CSDs. For example, students in CSD6 were more satisfied than CSD3 students by a magnitude of 1.5. The reasons for this become clear at the end of this section - 7.2.4- and are related to the absence in CSD3 of a first year GIS experience.

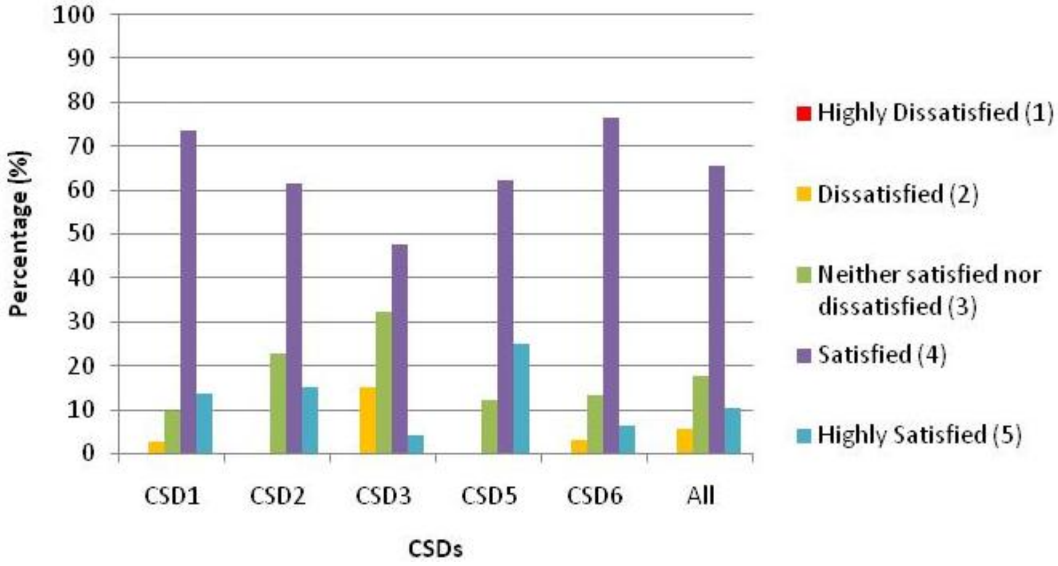


Figure 7.6: Students' level of satisfaction with their Geography GIS modules

Where the students hold satisfactory or better views on their GIS modules (categories 4 and 5), they put forward a variety of reasons. The most common highlighted the practical activities and the employability benefits (e.g. developing several marketable skills, such as IT skills, and the use of software). The following quotes illustrate students' positive views:

> It has been taught well and I have learnt a lot of new things (GUG15, CSD6).
>
> This has meant I can write on my CV that I have basic GIS skills (GUG73, CSD3).
>
> I have learned a lot and my experience has helped me with my job research (GUG92, CSD1).
>
> Very enjoyable, good lecturer, plus very helpful assistants (GUG103, CSD1).

Students who were less positive tended to comment again on the need for more practical work and their doubts about the value of a formal exam:

> The coursework practicals are useful, but I'm less sure about teaching for an exam (GUG120, CSD1).
>
> A lot of time was spent on course work practicals. A parallel formal exam too seems like a lot of work for 10 credits compared with other modules (GUG94, CSD1).
>
> Some more fieldwork for real analysis of variables would have been good (GUG25, CSD6).

> It is a lot harder than I expected and felt like we didn't get much help (GUG32, CSD3).
>
> I find it quite boring (GUG117, CSD1).

Despite some negative comments, the vast majority of students were satisfied or highly satisfied. That the lowest level of satisfaction occurred in CSD3 may again point to the absence of "taster" GIS teaching in year one. As a result, CSD3 students had less clear expectations and also little or no knowledge on which to build.

7.2.5 Wider use of GIS in the Geography degree programmes

To explore this issue, question, 4c, (see Appendix 2), a 5-point Likert scale (1=not at all, 5=always) and a related open-ended question were used. Brown and Olson (2001) implied that a GIS module alone might not help students to understand how GIS can be used across a range of different Geography topics (Human and Physical). It needs to be used more widely. In our study, Categories 1 and 2 (never and rarely) were selected by over 65 percent of GIS students (Figure 7.7). Less than 1 percent of students rated wider usage as 5 - 'Always'. Where the students nominated categories 3, 4 and 5 (together 34%), they typically referred to using GIS in their main dissertation or less commonly in a project within a fieldwork module. It must be remembered, however, that the GIS modules are generally in stage two and the dissertation in stage three, so some students are simply giving an expectation that they are likely to use GIS in their dissertation.

The year of study variable was further investigated by employing an ordinal regression analysis to identify any other factors relating to the students' answers on the wider usage of GIS outside the specialist modules**.** Year of study was found to be an influential factor. Interestingly, students taking a third year GIS module were apparently twice as likely to report a wider range of GIS teaching and learning than second year students (significant at the p=0.01). This may simply be because as final year students they had more experience or knowledge about places in the curriculum where GIS was found.

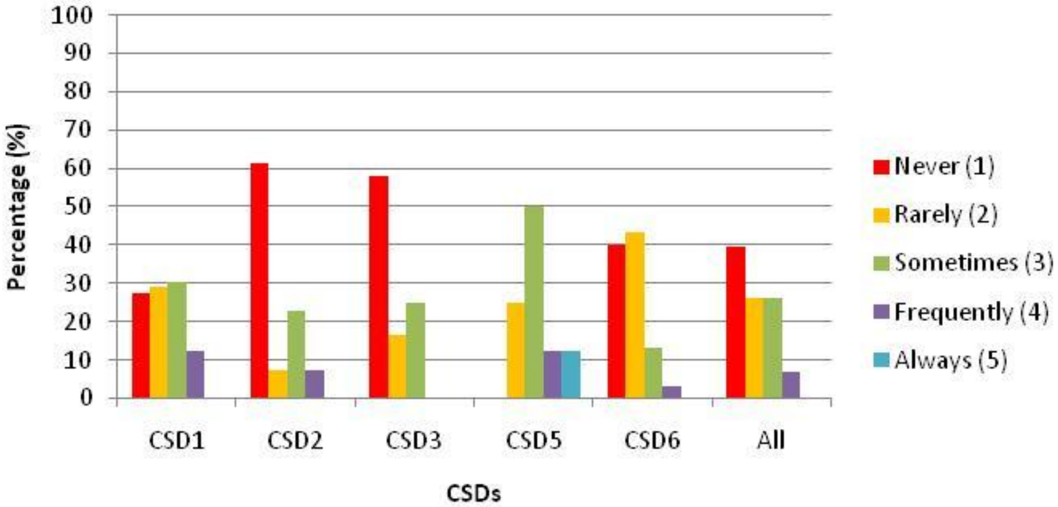


Figure 7.7: Students' views on the wider use of GIS in their Geography programme

In the dissertation module some final year students had used GIS to identify a location for their research site. A small number of students using GIS in another Geography module (not the dissertation) employed it in the form of spatial analysis techniques such as buffer zone and suitability analysis (However, it should be emphasised that this particular experience is limited to a single module in one department, namely CSD1. Only one the CSDs ran a work-based learning module (Gedye et al. 2004) and so the possibility of using GIS in this kind of placement was not present. The words below came from a student who, unusually, made use of GIS in both another module and in their dissertation:

> I made use of it in my Retail Geography module to choose a site for a new supermarket and in my dissertation to map population density and Tomsend Deprivation indicators in Milton Keynes for a time series study (GUG132, CSD1).

Another issue to be considered in this section is how different GIS teaching and learning is from other Geography modules. As shown in Figure 7.8, the majority of student responses highlighted that the practical and computer-based features of GIS modules make them distinctive. So, although the students often wanted more practicals in their GIS modules, they did recognize that GIS already has a stronger practical emphasis than most other parts of their degree programme.

Figure 7.8: Tag cloud of answers given to the question on what differentiates GIS from the other Geography modules

7.3 GIS Degree Students' Experience

Having provided an account of Geography students' views about their GIS experience in the undergraduate (UG) Geography programmes, attention now moves to student perceptions of the specialised GIS programmes (MSc and UG). Readers may find the Masters level discussion of particular interest because the existing literature on Masters teaching and learning is limited in size and scope (Kneale 2005, McEwen et al. 2005, McEwen et al. 2008).

That the GIS Masters students generally had strong employability motives for choosing their post-graduate programme is not surprising. Those coming from "academic" first degree subjects, such as Geography, were looking to direct their

Masters level education into a more overtly vocational area; and those already in professional posts were looking to upgrade their existing expertise.

The wider literature outside of Geographical education also points to the vocational role of most Masters courses. For example, a study by Watkins (2011) on the motives for choosing Masters courses in the nursing and health fields also found that students were motivated principally by the opportunity to focus on complex and advanced health related issues relevant to their existing job or profession. They wanted to increase their knowledge and skills in ways which would improve their performance in their current post and/or provide the necessary qualifications and credibility to advance their careers in the longer term. Glover et al. (2008) found similar results in the study of physiotherapists taking Masters. More generally, a study published by the HEA (2012) revealed that two most common reasons for taking Masters courses are "to increase my employability prospects" and "to progress in my career path". The data for this HEA study were derived from the most recent UK Postgraduate Taught Experience Survey (PTES) and covered all disciplines. Clearly GIS Masters students are not unusual in their vocational ambitions.

7.3.1 Characteristics of students in the GIS Masters and the Undergraduate GIS programme

As can be seen in Table 7.2, unlike the Geography UG students, the number of males is rather higher than the number of females in both the MSc and UG GIS programmes. However, the numbers of respondents for MSc and UG GIS programmes are respectively 28 and 10 and so in both cases the relatively small sample size makes it difficult to draw definitive conclusions on gender balance. The literature (see Schuurman 2002) suggests that computer-oriented subjects are generally more attractive to males. Given that the GIS Masters and UG programme have a much stronger IT-focus than the 'general' Geography programmes, there is some evidence from this PhD research to support this view but the numbers are too small to draw firm conclusions.

With respect to their age profile, the UG GIS programme follows a similar pattern to the Geography programmes (most being 18-25 years olds). By contrast, the MSc programmes are dominated by older students, as is commonly the case at Masters level. The high proportion of part-time students is also common on vocationally-oriented Masters courses (Table 7.2), with many continuing in their existing job (often with a day-release arrangement) and taking an extra year to complete. Comments from staff suggest that the Masters students came from a wide variety of professional backgrounds with only a small minority already having substantial experience in a GIS post. There was also considerable variation in their previous study of GIS – a mix which made it difficult for staff in the early stages to teach at a level which would match all the students' needs and abilities.

Table 7.2: The main characteristics of UK survey participants: MSc and UG GIS students

Students' demographic features				
	MSc GIS		**UG GIS**	
Demographic attributes	**Frequency**	**(%) Percentage**	**Frequency**	**(%) Percentage**
Gender				
Female	12	43	4	40
Male	16	57	6	60
Total	**28**	**100**	**10**	**100**
Age Group				
18-25	5	18	9	90
26-33	12	43	1	10
34+	11	39	-	-
Total	**28**	**100**	**10**	**100**
Type of Study				
Full-time	4	14	10	100
Part-time	24	86	-	-
Total	**28**	**100**	**10**	**100**
Total	**28**	**100**	**10**	**100**

With respect to the reasons students gave for enrolling on the MSc degrees, by far the most important factor (61%) was employability. This result also supports the idea of McEwen et al. (2008) that GIS Masters programmes can be classified under the heading of 'vocationally-oriented' post-graduate studies, though not all students are working towards a career focussed entirely in GIS:

> I'm in the international development/humanitarian aid sector which has become increasingly dependent on GIS tools to aid in decision-making and the presentation of results to a variety of communities. I believe that this programme will help me change my career path into areas that I am more interested in (GISMSc16, CSD2).

Unlike the MSc students' views, the UG GIS programme students pointed up subject appeal as the foremost reason for choosing it (83%), with the remaining answers focussed on employability (17%).

7.3.2 Teaching and learning activities

As can be seen in Figure 7.9 on the MSc programmes, activities 2 and 3 (in-class projects and exercises) came out as the most frequently used activities, while categories 9 and 12 were found to be the least used activities (primary data collection and placement learning). These results are similar to those in the UG Geography GIS modules, suggesting that the teaching methods used are not very different between Masters and UG Geography. The absence of a placement experience at Masters level is perhaps expected because most of the students are already in work.

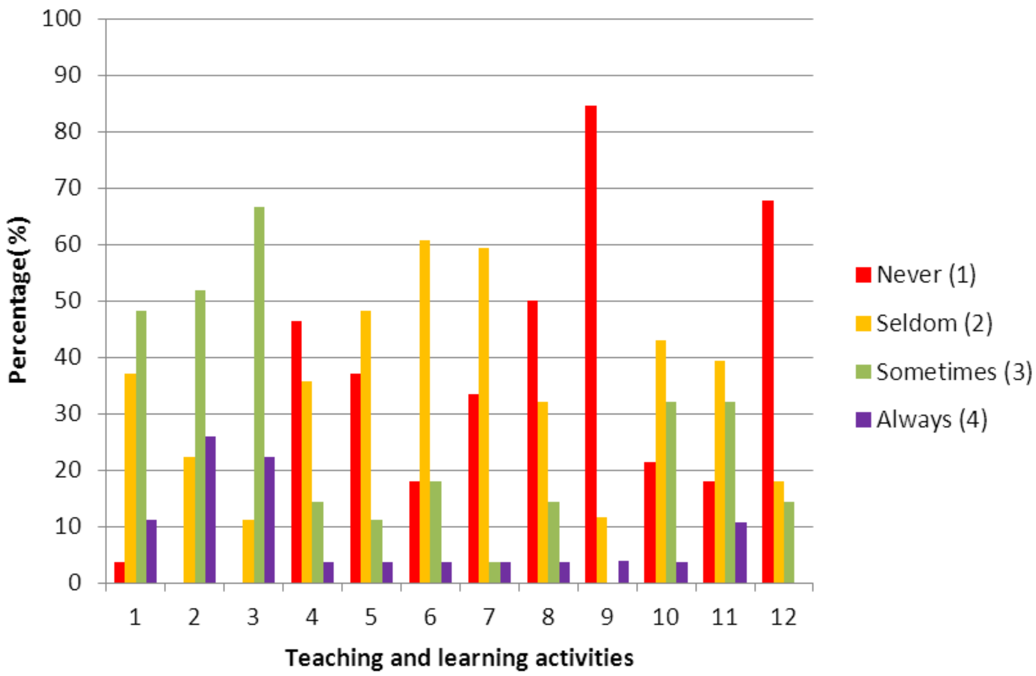


Figure 7.9: Frequency distribution (%) of respondents' answers on the amount of use made of various teaching and learning activities (MSc programmes) *(**Key: 1.**GIS project planning tasks.; **2.** Undertaking GIS project (s).; **3.** Structured GIS activities in a computing suite.; **4.** Mobile GIS using activities by handling Notebook or PDA.; **5.** Data collection activities by using compass or other analogue survey methods in the field.; **6.** Data collection activities using GPS in the field.;**7.** GIS using activities in the field.; **8.** Orienteering activities in the field using GPS, GIS or maps.; **9**. Primary data collection activities e.g. interviews or questionnaires.; **10.** Presenting results of GIS activities (either oral or poster presentations).; **11.** Secondary data collection activities in field or online.;**12.** Work-placement learning activities in real working environment).*

Unlike the Masters students' opinions, the UG GIS students' views reflect slightly different experiences of the teaching and learning pattern, although the most frequently used activity remained the same (activity 3-structured activities in the lab). However, the activities 5, 6, and 7 (all dealing with field-work based activities) were appreciably more prominent (Figure 7.10). This form of experiential learning emerged as a key feature of the UG GIS programme, unlike any of the MSc GIS programmes (see section 2.3 in chapter 2) or the Geography UG GIS modules. Presumably, in a full three year GIS undergraduate course, there is more time to include GIS-related fieldwork.

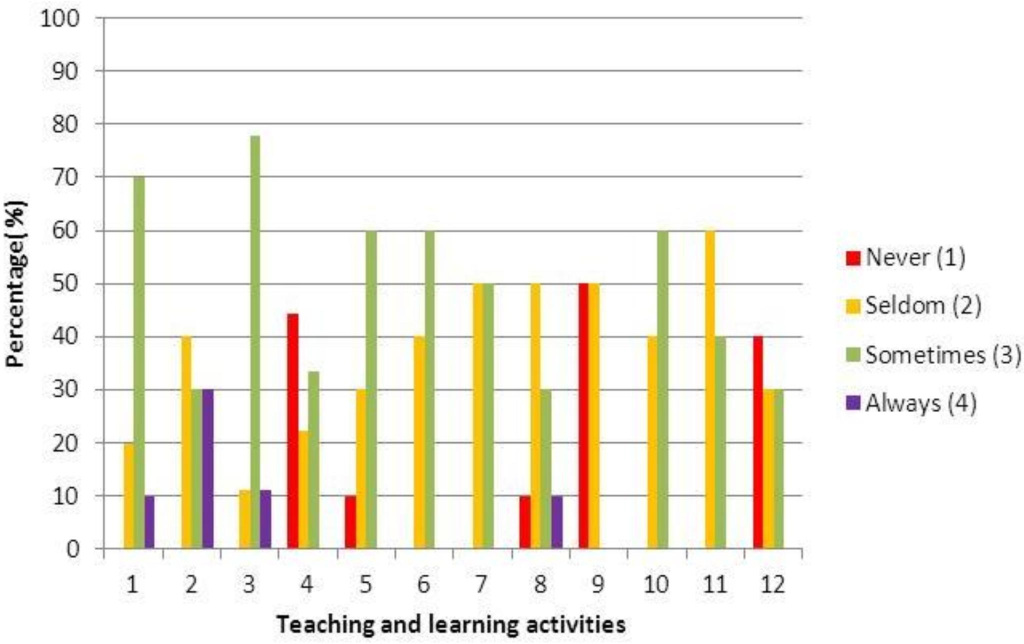


Figure 7.10: Frequency distribution (%) of respondents' answers on the amount of use made of various teaching and learning activities (the UG GIS programme) *(**Key:** 1. GIS project planning tasks; 2. Undertaking GIS project (s).; 3. Structured GIS activities in a computing suite.; 4. Mobile GIS using activities by handling Notebook or PDA.; 5. Data collection activities by using compass or other analogue survey methods in the field.; 6. Data collection activities using GPS in the field.; 7. GIS using activities in the field.; 8. Orienteering activities in the field using GPS, GIS or maps.; 9. Primary data collection activities e.g. interviews or questionnaires.; 10. Presenting results of GIS activities (either oral or poster presentations); 11. Secondary data collection activities in field or online.; 12. Work-placement learning activities in real working environment).*

The review of GIS Masters students' opinions on the most valuable parts of their programmes revealed that the subject content (68%) was the most useful element. The part-time students also commented on the timetable benefits of delivering at least some of the teaching in the evenings. Answers on the least valuable parts of the Masters programmes focussed mainly on the lecturers spending too much time on the theoretical background (again not unlike the Geography UG comments). This is an issue which will be returned to in the next chapter on employability.

Another criticism was that for some MSc students, in places the curriculum covered areas in which particular individuals already had expertise and even workplace experience:

> So far I would say the least valuable aspect has been the introduction to programming. As I have been working as a GIS developer for the last five years, I already knew what was taught (GISMSc17, CSD2).

Some also commented that their programme was not ideal because the balance between physical and human geography did not align closely with the nature of their job:

> For instance, satellite images: I work in social science disciplines, so whilst I enjoyed learning it, it is not that relevant (GISMSc12, CSD2).

However, given the diversity of MSc students' professional backgrounds, it is difficult to see how this problem could be readily overcome, not least because the introduction of more options in particular specialism would be expensive.

Additionally, some students complained about the intensity and workloads in the Masters programmes. This relates to the particularly demanding nature of Masters courses in the UK (180 credits within a one year period for full-time students or 2 years for part-time students). The UK is very unusual in offering one year full-time Masters.

> Too many deliverables in a short semester 2. Better quality of work would have been possible with more time (GISMSc26, CSD1).

When looking at the UG GIS programme, students found the most valuable teaching methods to be the computer-based practicals, the fieldtrips and the dissertation. In addition, some students found the infrastructure and facilities of this department particularly helpful, including the GPS, Total Stations, mapping packages and the computer room. Two students also commented positively on the emphasis on skills such as project management, surveying and mapping skills. They were not thought to be relevant enough to GIS.

Interestingly, some GIS UG students found the least valuable aspects of their programme to be the elective Geography-oriented modules, which were part of the department's Geography degree.

> Collaboration with Geography department, I had to study irrelevant modules (GISUG2, CSD4).

7.3.3 Assessment

With respect to how far assessment promoted learning, 81.5 percent of Masters students said 'a great deal' or 'much' (categories 5 and 4) (see Figure 7.11).

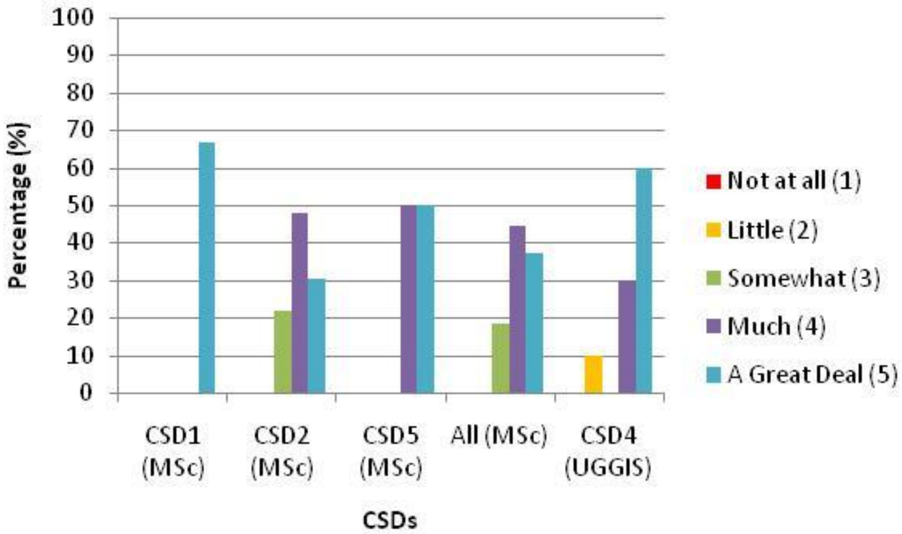


Figure 7.11: Students' opinions on the value of the assessment process for their GIS learning

When looking more closely at their responses, it is clear that assessment (which was all coursework at Masters level except for CSD2) allowed them to investigate key concepts and to practise analysis techniques. For instance:

> As I have no working experience in GIS, the assessment exercises and coursework have given me a touch of real world feeling (GISMSc19, CSD2).
>
> My coursework has exposed me to different scenarios from those I have seen while working in the GIS industry (GISMSc17, CSD2).

With reference to GIS UG students, nearly 90 percent said that assessment helped them to develop their skills and knowledge. Here too the benefits of various coursework assignments were highlighted. For example;

> Undertaking projects has been the greatest area of learning, when doing it and working out how stuff works (GISUG1, CSD4).
>
> Practical sessions, coursework and my dissertation have improved my GIS knowledge greatly (GISUG5, CSD4).
>
> Projects make you think and discover (GISUG1, CSD4).

So although there are also unseen formal exams in the UG GIS programme, its students too felt the assessment of various kinds of active learning (such as projects and dissertations) was more beneficial. However, another interpretation could be students do not like examinations and some find them difficult.

7.3.4 Students' expectations and satisfaction levels

Overall, three-quarters of Masters students said that their course met their expectations, either 'to a very great extent' (29%) or 'to a great extent' (46%). Figure 7.12 does show some contrasts between the CSDs in how far they met students' expectations but, given the small sample size, these should be read carefully.

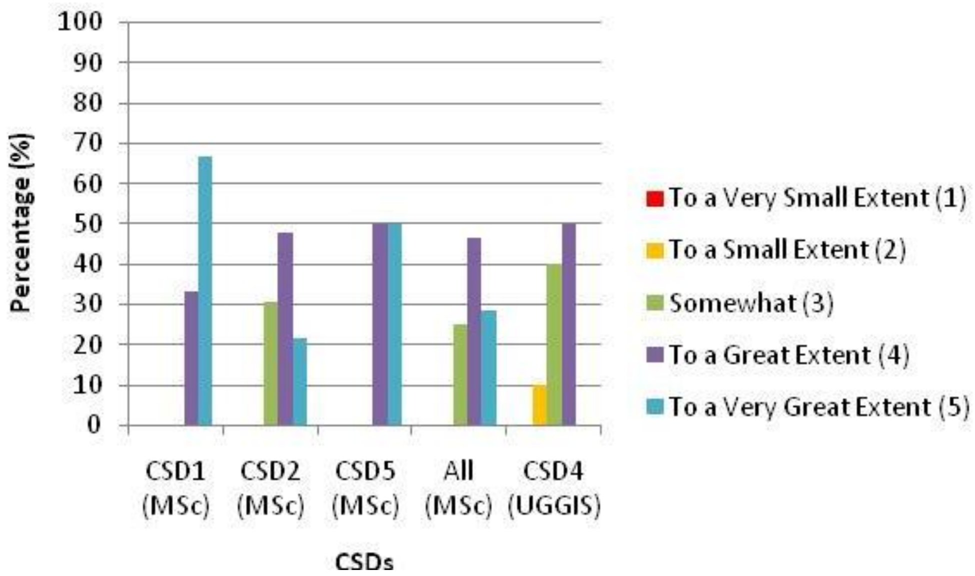


Figure 7.12: Students' answers as to how far their expectations were met (Masters and UG GIS)

The most common reason behind Masters students' expectations being met is shown by the following MSc students' quotes:

> This programme exemplifies the many uses of GIS and various transferable skills for any industry (GISMSc25, CSD5).

> This programme has exposed me to many aspects of GIS. The programme has successfully woven together hands-on work with broad exposure to GIS theory. (GISMSc16, CSD2).

In contrast, the GIS UG programme student opinions (though the number of UG GIS students was small) were a little less positive. None felt that their expectations had been met to 'a very great extent'. However 50% answered "to a great extent" and 40% opted for the mid-point category, namely 'somewhat'. Only one of the ten UG students answered "to small extent" (10%). Some students articulated a little disappointment with the content of the programme:

> I would have preferred more coding and software coding (GISUG3, CSD4).

Additionally, embedding Geography modules into the GIS UG programme appears not to be welcomed by the GIS students and for some was an unexpected feature of the UG GIS programme:

> The GIS sections are good but this year there has been a greater focus on general geography (GISUG8, CSD4).

With reference to the overall satisfaction of the specialist GIS programme students, taken together 85 percent of students were satisfied or very satisfied with the education they received (Figure 7.13). This is obviously encouraging finding.

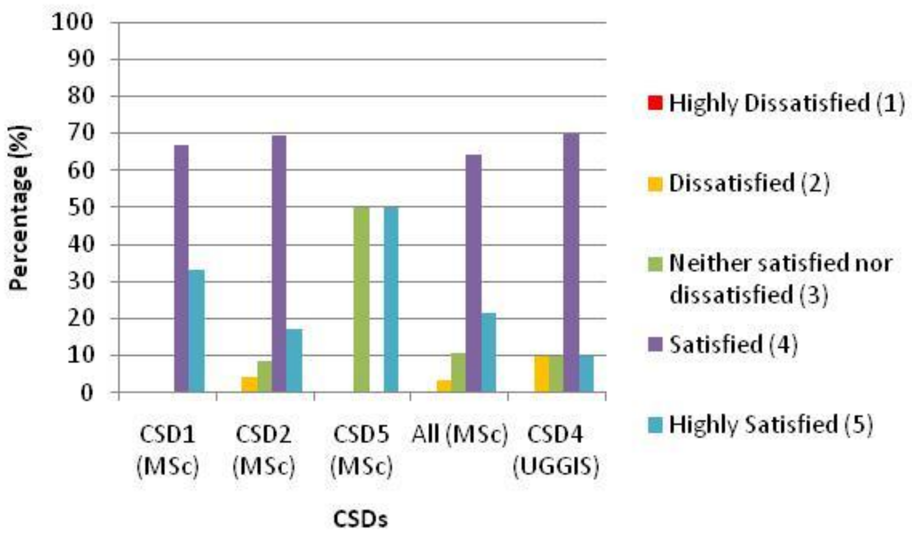


Figure 7.13: Students' levels of satisfaction with their specialist GIS programmes (Masters and UG GIS)

7.4 Synopsis and Evaluation

This chapter has focused on students and the student GIS experience, first in Geography and then in the specialist GIS programmes. Based on the research evidence, for the vast majority of Geography students, the availability of a GIS module played no part in their degree-level subject choice. Although there have been some moves to encourage GIS teaching in schools, the clear impression is that levels of GIS awareness prior to HE entry are very low, which raises questions about the general profile and visibility of GIS. Even prospective Geography degree students seem to have very limited awareness of it.

The main reasons for Geographies choosing a GIS module were the perceived employability benefits, because it sounded interesting and because it was expected to connect with and be useful to other parts of the Geography degree. In this latter respect the students' expectations were for the most part too optimistic. Students did not often encounter GIS outside the specialist option, unless they chose to use it in their dissertation. Given the importance of students practising their skills and applying them in different contexts, this finding was disappointing and needs to be addressed.

Equally, it is important that any 'taster' GIS teaching, while setting out an attractive option menu, should appraise students honestly about the generally modest extent to which GIS currently touches, illuminates and is used in other parts of the programme. For students for whom no first year 'taster' was provided their expectations of the GIS module were less likely to be met.

Nonetheless, the research provides clear evidence that the GIS modules were overall well received, with generally high level of student satisfaction (as is the case for Geography degrees generally in their NSS results). Students considered the hands-on learning in the practical exercises and assignments to be particularly useful, which confirms the previous work of Lloyd (2001) and Chen (1998). The students were much less impressed with the theory lectures. Students were either not receiving, or failing to hear, the views of their lectures on how valuable the theory can be in the professional, workplace environment (Whyatt et al. 2011). This perceived tension between theory and practical in GIS education is clearly another issue which needs to be addressed. The current disconnection is frustrating both students and staff, damaging the students' experience and possibly reducing GIS recruitment (recommendations on this and other aspects of GIS education are made in chapter 10).

The survey evidence reinforces the key general role of assessment in nurturing learning (Bond and Falchikov 2007) as previously confirmed by Shepherd's (2009) experience of assessment in relation to GIS teaching in the disciplines of Business and Marketing. However, the PhD survey results also showed the all too familiar problems which affect Higher Education assessment and in particular the slow return of coursework and sometimes poor quality of feedback, as regularly revealed in the National Student Survey (NSS). It is interesting how little attention students gave to the relationship between ILOs and assessment- a relationship which in theory is at the core of the assessment process but which does not seem to appear on the students' agenda. This too is an issue which needs attention.

Finally, in relation to students' complaints about assessments and lectures, it has to be recognised that these are not always firmly grounded in reality. For example, there were a few sharp complaints about lack of help from staff with respect to practicals and projects. Although as an "outsider" it was difficult for me to judge the validity of these comments, the evidence of my classroom observations (admittedly itself open to bias) was of highly approachable staff and classroom assistants doing their best to help all the students who needed it.

Although most of the themes and issues referred to above were also relevant to the students on the specialist GIS programmes at MSc and UG level, these course also had some distinctive features. The MSc students, who were very employability oriented, were particularly positive about real-world examples and professional case-studies and assignments. Many Masters students were losing a year's salary as well as paying substantial course fees: for them the need to acquire and develop new skills for the workplace was crucial. Although there were a few complaints about the speed and intensity of the course, they recognized that the heavy workload was the price of securing a Masters qualification in a year. Their diversity of backgrounds and needs meant not all parts of the teaching was equally relevant to each individual but nonetheless their overall satisfaction levels were high.

Students on the GIS undergraduate course were a little less positive but their small numbers (n=10) make it difficult to draw strong conclusions. Interestingly, one of their distinctive complaints was that they had an occasion to take modules from the Geography undergraduate programme. Presumably, these GIS students had deliberately decided to take a GIS degree in preference to Geography and therefore felt dissatisfied when required to take a non-GIS module from Geography. For them, the possible benefits of a broader education were not enough to compensate for a reduction in their GIS focus.

CHAPTER 8 : GIS AND EMPLOYABILITY IN THE UK

8.1 Introduction

Whereas the focus in the first three results chapters was on the provision and pedagogical aspects of GIS education, the emphasis in chapter eight now moves on to the employability issue, a subject of considerable importance and topicality, not least in the light of the recent Higher Education White Paper (BIS 2011).

In this part of the thesis, the employability dimension is discussed principally from the perspective of three key stakeholders, namely staff, students and GIS employers. The structure of this chapter has an academia section focusing on the views of GIS students and lecturers (see section 8.2) and then a section on GIS employers' perspectives (see section 8.3) which includes a review of job advertisements. It should be acknowledged that one of the stakeholder groups in this chapter could also have been relevant Geography alumni; however, the overall PhD data collection process was inevitably limited by time and financial constraints and also the rigid administrative and ethical processes used in the Alumni Offices would have made identifying and contacting former students difficult (see section 4.6). Therefore, past students were not surveyed, although some reference is made to other geography studies which have examined alumni views on their courses (e.g. Brown 2004, Clarke and Higgitt 1997, Gedye et al. 2004, Hennemanna and Liefnera 2010, Solem et al. 2008, Whyatt et al. 2011). Although the majority of the data in this chapter are drawn from primary data sources (i.e. the students' questionnaire and lecturer interviews), some secondary data sources such as GIS "job ads" and programme/module documentation were also included in the analysis process which principally focused on the following kinds of questions:

- What sorts of GIS skills do students acquire?
- How well does the GIS teaching equip students for the world of work and especially GIS careers?
- Do GIS lecturers think that the GIS skills acquired by their students are high enough to get a job in the GIS market?
- What kinds of attributes do GIS employers expect from their new graduate employees and how well do Geography and GIS programmes satisfy these expectations?
- What kinds of GIS jobs are offered by employers?
- What are the likely future trends in the GIS job market?

8.2 Perspectives from Academia

This section considers the views of the students and lecturers (GISLs), both at UG level and Masters level, on the employability potential of GIS education.

8.2.1 Students' perspectives

As underlined in section 7.2, the majority of UG Geography students who took GIS modules did so because they saw the employability potential of GIS. This section considers their skills development (GIS and transferable skills), alongside their opinions about future career pathways. These results will later be compared with the spectrum of GIS and transferable skills which are valued by the GIS employers (see section 8.3).

GIS and transferable skills

Students were questioned as to the extent to which they improved their GIS and transferable skills, using four-point and three-point Likert scales (see Appendices 2, 3 and 4). The aim was to find out how much the students felt employability was enhanced as a result of their GIS education. In relation to GIS skills, students were assessing their competency level (e.g. ‘basic’, ‘advance’): in relation to transferable skills, students were assessing their improvement as a result of taking GIS module(s)/ a GIS course.

With respect to GIS skills, Geography students were asked to self-gauge their competency levels in 34 GIS skills that included a set of mainstream and more advanced GIS skills. As can be seen in Figure 8.1, the majority of students considered their mainstream GIS skills (including running some spatial analysis and using software tools) to be at the level of “know the basics” or “moderately skilled”. In contrast, the vast majority of answers for advanced level or complex GIS skills (e.g. starting in Figure 8.1 with item 26 such as programming and scripting) were rated at the unfamiliar level. These results were essentially as expected given the nature and scope of the curriculum of the Geography-based GIS modules (see section 5.3.3).

Overall, the key message is that the great majority of advanced skills did not show any improvement regarding the students’ confidence in their level of ability to use GIS skills. Although the survey questionnaire provides only an approximate indicator of students’ skills levels (in relies on self-assessment), the fact that taking a second module does not generally appear to raise skills levels does raise a question-mark about the benefits added by Geographers taking a second option in GIS. Given that the second option is generally in a particular field (e.g. Physical Geography) (see section 7.2), perhaps students do not deepen their GIS knowledge very much, but instead they apply it in a particular area. Certainly it would seem a good idea for students to extend their GIS education by taking an extra module but the additional value of this needs to be made clear and fully explained to students. Attention should also be given to the possibility of deliberately including a module which focuses on rather more advanced GIS, and less on a particular area of application.

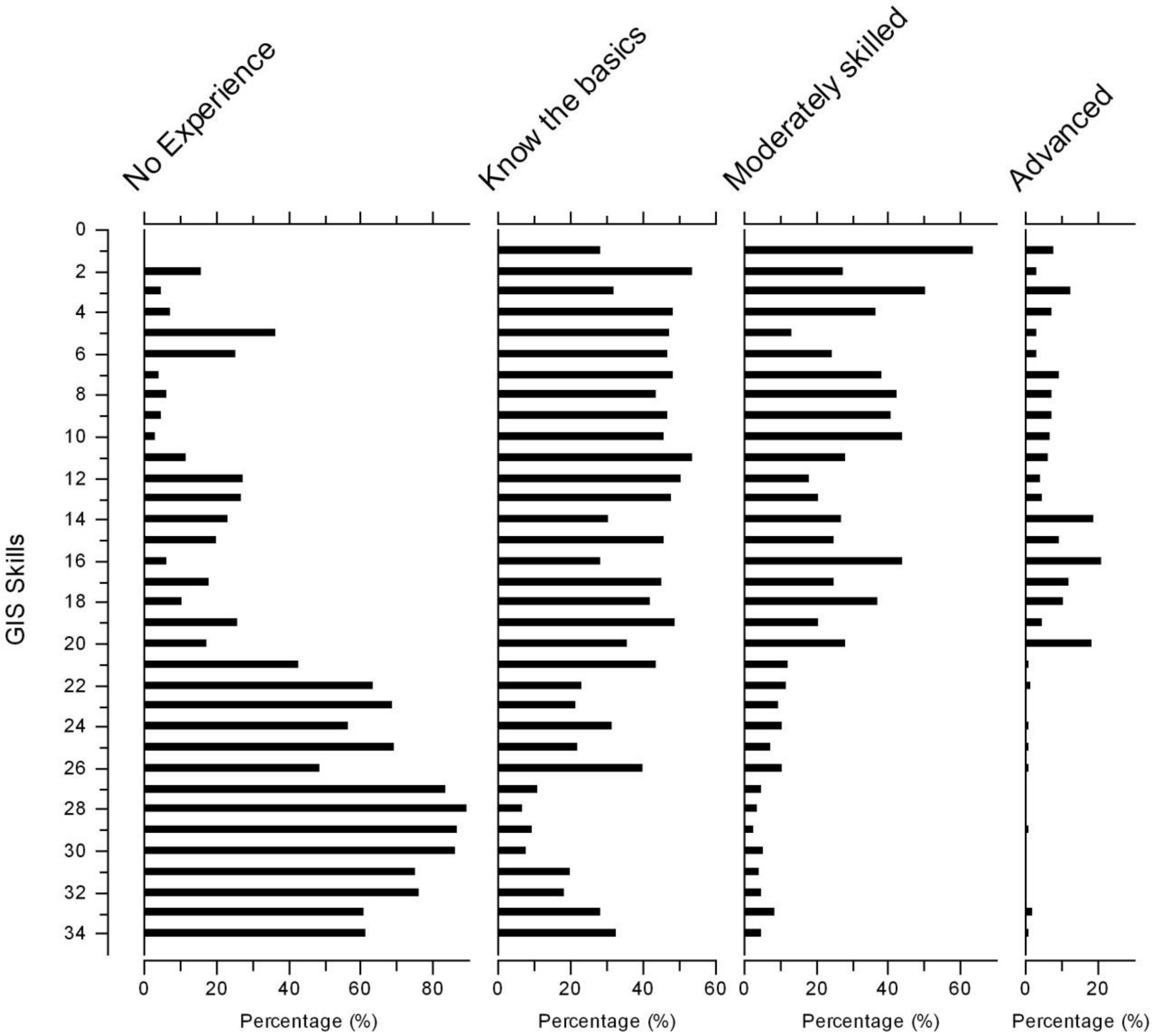


Figure 8.1: The views of UG Geography GIS students on their GIS skills levels (n=175)
(The key for this graph is provided on the following page)

Table 8.1: The key for figures 8.1, 8.2 and 8.3 and for 9.18 and 9.19

GIS Skills	GIS Skills (Continued)
1.use software tools	18. do overlay and intersection analysis
2.use geometric measurement techniques	19. do neighbourhoods analysis (e.g. filters, cluster analysis)
3.load and explore national datasets	20. create Layouts to produce high quality output mapping
4. create geo referenced spatial data	21. run multi-variety statistical analysis
5. create spatial and attribute queries with the help of SQL	22. run hillshade or solar radiation analysis
6. create spatial data bases	23. make network analysis
7. import spatial data from different sources	24. select and run appropriate interpolation methods
8. select suitable map projections according to aims and geography locations	25. undertake post-processing of GPS
9. edit spatial data	26. develop conceptual data models
10. classify data	27. script GIS processing tools (e.g. using Python)
11. undertake multi-criteria selection analysis on attribute data	28. create a web-based GIS application (JavaScript and PHP)
12. create vector based data by using digitizing techniques	29. set up a GIS online database
13. create vector data through importing coordinate points	30. use programme language (e.g. using C, C++, Java etc.)
14. create choropleth maps	31. apply relationship classes in object oriented databases
15. create density maps	32. develop complex data processing models through batching tools together
16. do buffer zone analysis	33. visualise field and object data in 3D
17. do point-in-polygon analysis	34. develop and enforce topological rules when creating spatial data

The views of the students on the specialist UG GIS programme were not so very different from those of the Geography undergraduates, as can be seen from Figure 8.2. However, the Masters students claimed competency levels in mainstream GIS skills which were substantially higher (Figure 8.3). In addition to this, their capability to use some advanced level GIS skills showed slightly different results from those of UG Geography GIS and the UG GIS programme students. However, this difference is not quite as visible as had been expected. The main reason for this may be that students tend to 'benchmark' against other students on their course. In the case of the Masters students, some may also have judged their skills in comparison with employer expectations or against colleagues in the workplace. The survey data therefore need to be interpreted cautiously: they almost certainly understate the scale of the real differences in competency levels between the different groups of students.

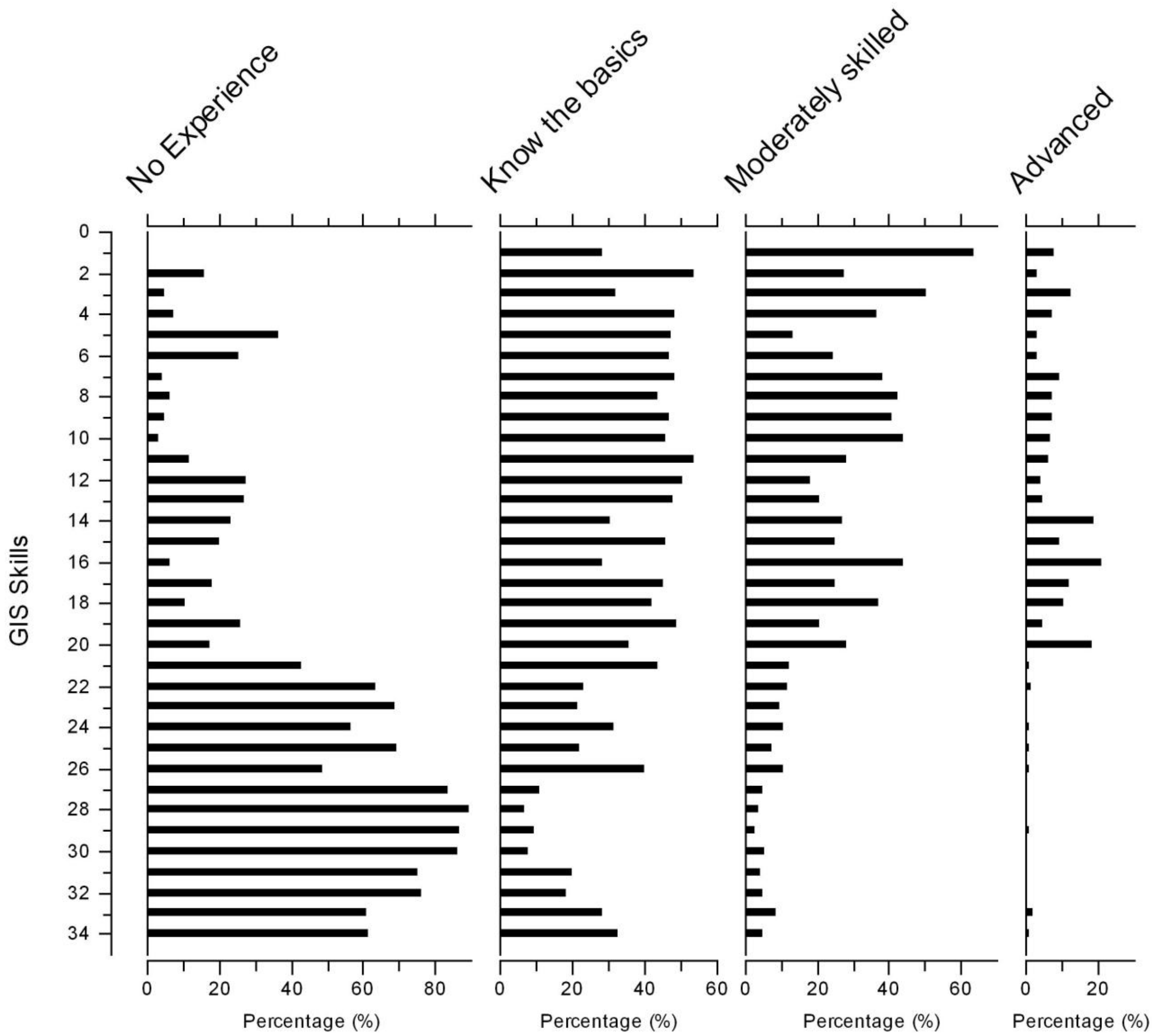


Figure 8.2: The views of UG GIS students on their GIS skills levels (n=10) (The key for this graph is provided on Table 8.1)

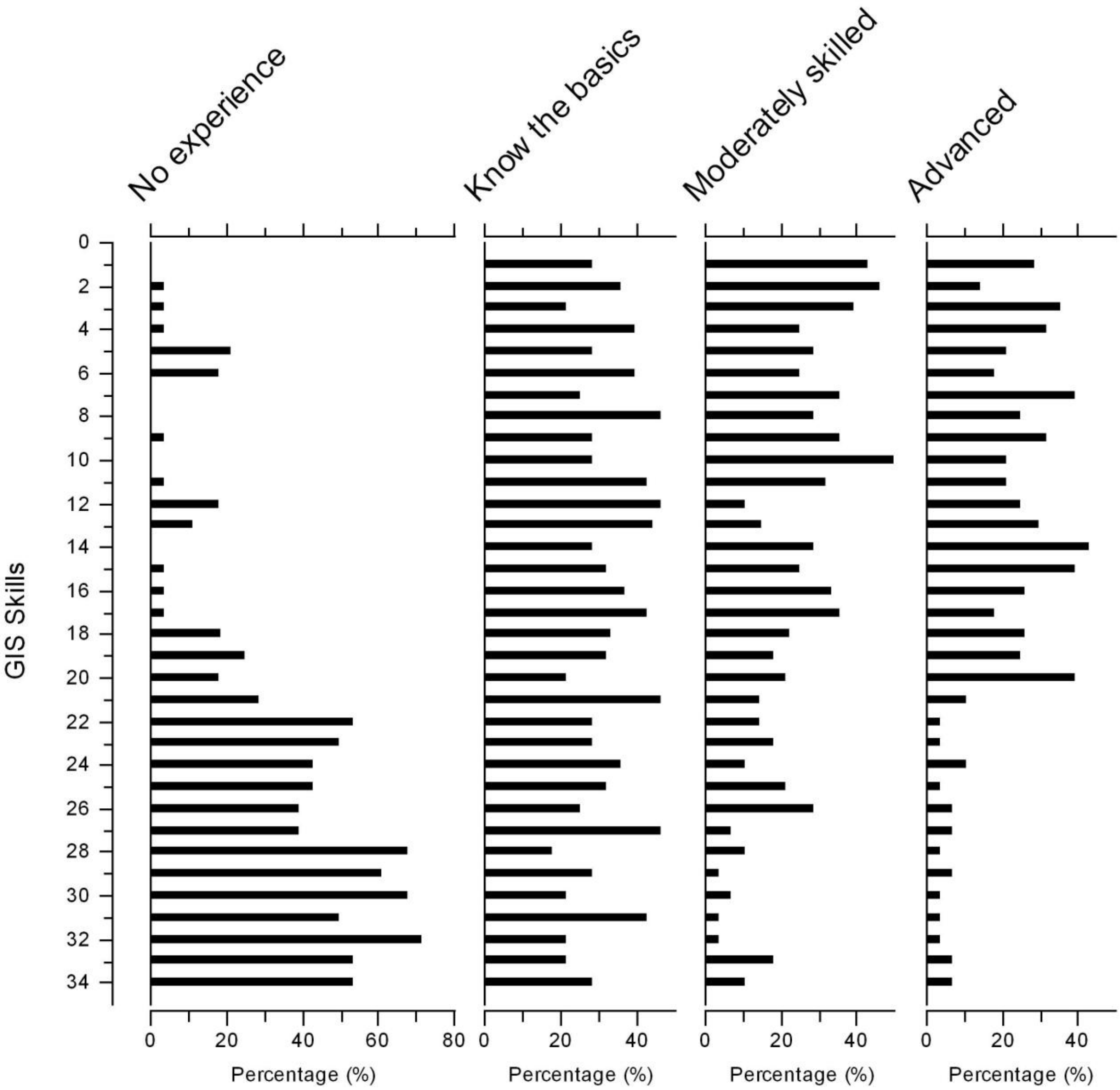


Figure 8.3: The views of GIS Masters students on their GIS skills levels (n=14) (The key for this graph is provided on Table 8.1)

Note: when generating this graph, some of the MSc students in the CSD2 were eliminated from the analysis, because they were part-timers in year one and it was too early from them to make reflective judgements. This is also the same for Figure 8.5.

With reference to transferable skills, Haigh and Kilmartin (1999) noted that they were highly valued by both Geography students and academic staff. In the present study, problem solving and research skills came out as the skills which GIS teaching enhanced most among the UG Geography students, while the levels of improvement were much less marked for such skills as team working, leadership, and particularly empathy and insight (Figure 8.4). Of those, team working is a particularly important skill for the employability of graduates in the GIS market, as argued by Owen (2001), Brown (2004) and Solem et al. (2008). Additionally, Gedye et al.'s work (2004) showed that Geography graduates later experienced poor quality team working in the real professional environment. One important impediment to team-working exercises in the curriculum is the perceived need for individual-based assessment scores and this was certainly the case in the GIS modules featured in this research.

Additionally, ESRI UK's (2011) survey of 200 GIS businesses showed that 78 of those participating rated critical thinking as one of the important skills they look for when recruiting graduates. In this PhD study, critical thinking was also nominated by the UG Geography students as one of the skills most enhanced by their GIS module(s). This may perhaps relate to the inherent difficulty of some of the GIS curriculum material and from the complexity of the project assignments.

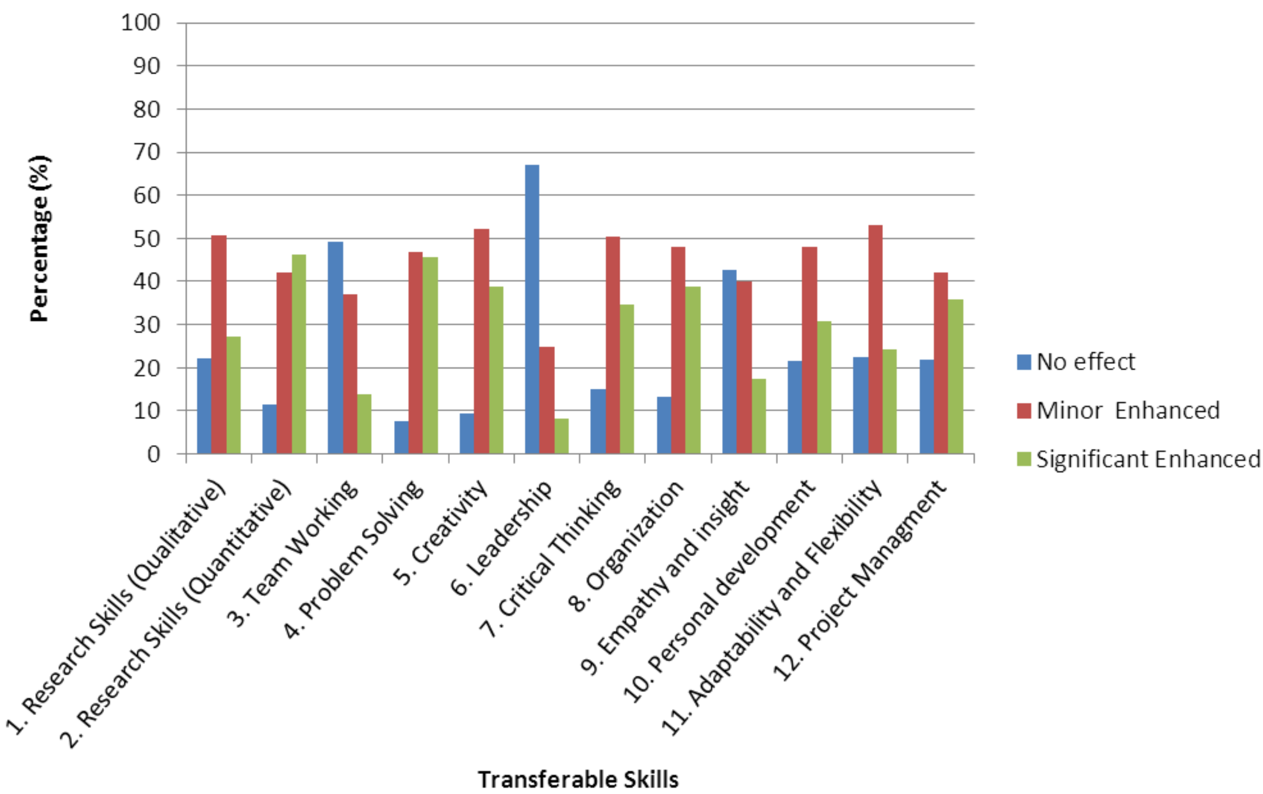


Figure 8.4: The transferable skills impact of the GIS module(s) as rated by UG Geography students

With respect to general transferable skills, the overall responses from the UG GIS programme students showed better results than those from either the UG Geography students or MSc students. Specifically, the GIS UG students' team working skills and project management skills seemed to be improved more when compared to the rest in the list (see Figure 8.5) (though the low numbers of students on this course must be borne in mind). This might be related to the presence of a stand-alone project management module in the UG GIS programme. However, it must be remembered that a major reason why the GIS UG students show a generally much more positive view of their skills enhancement is probably that they were commenting on the skills impact of their whole programme rather than a single Geography (GIS) module. That the UG GIS programme also appears to outperform the Masters GIS programme may also simply reflect the difference in perceived skills impact between three and one year (full time) courses.

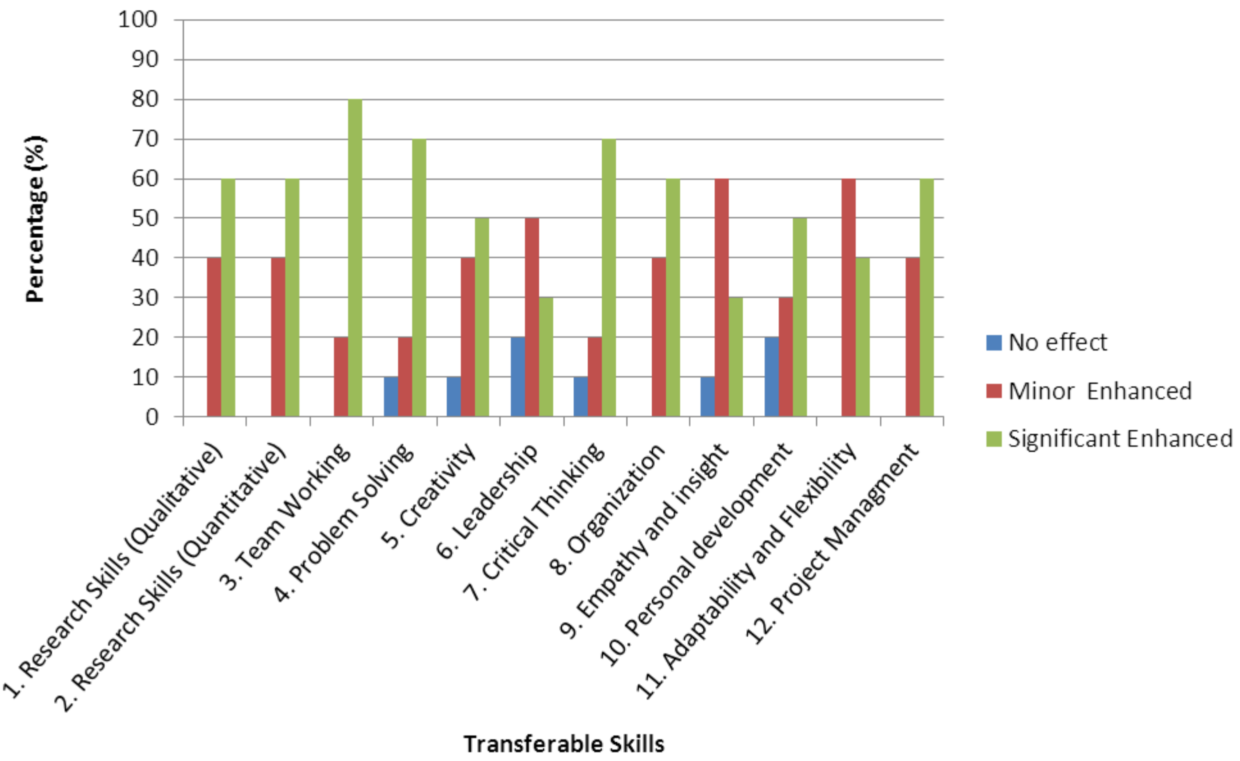


Figure 8.5: Transferable skills (self-assessed) of UG GIS students

A key point from this evidence is that the Masters courses generally report a positive impact on their transferable skills particularly in areas such as research skills, creativity, problem solving, critical thinking, organisation and personal development. This is particularly important given that the main reason for taking the Masters course was employability.

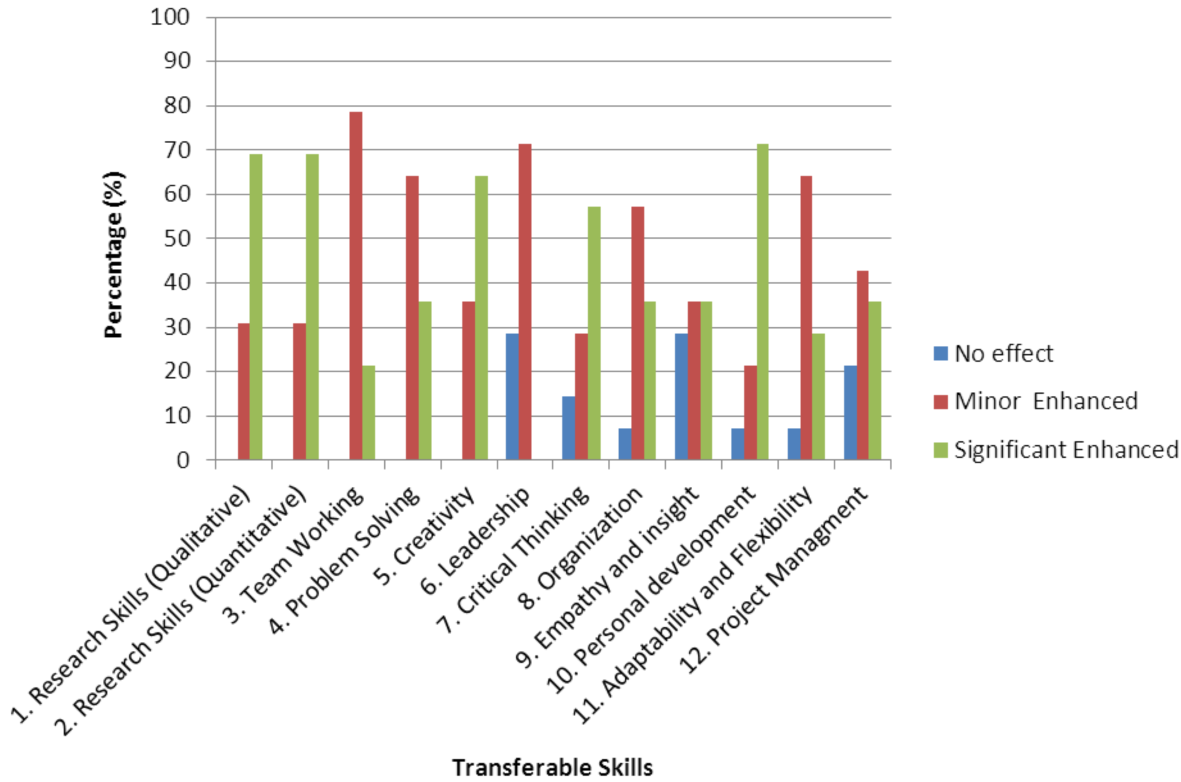


Figure 8.6: Transferable skills (self-assessed) of Masters GIS students

Additionally, as can be seen in Figure 8.7, the average self-assessment values for all the GIS skills were calculated and presented as a line graph in order to make a visual comparison between the three different types of GIS provision. The results showed that the average score for Masters students' views on GIS skills is at the top. This is generally true both for the more basic skills at the left hand side of the graph and also for the advanced skills at the right hand end. Masters GIS students seem therefore to outperform the others with respect to technical skills. Regarding transferable skills, the average scores for the GIS UG students' self-assessment (mean=2.48), and for the GIS MSc (mean=2.34) are higher than for Geography UG students (mean=2.05)[14]. This probably reflects the fact that one or two modules alone have less opportunity for developing transferable skills than whole GIS programmes.

[14] These scores are based on the scale where 1 indicates that students perceived there is no effect on their trasnferable skills. The top score of 3 indicates a significant enhancement.

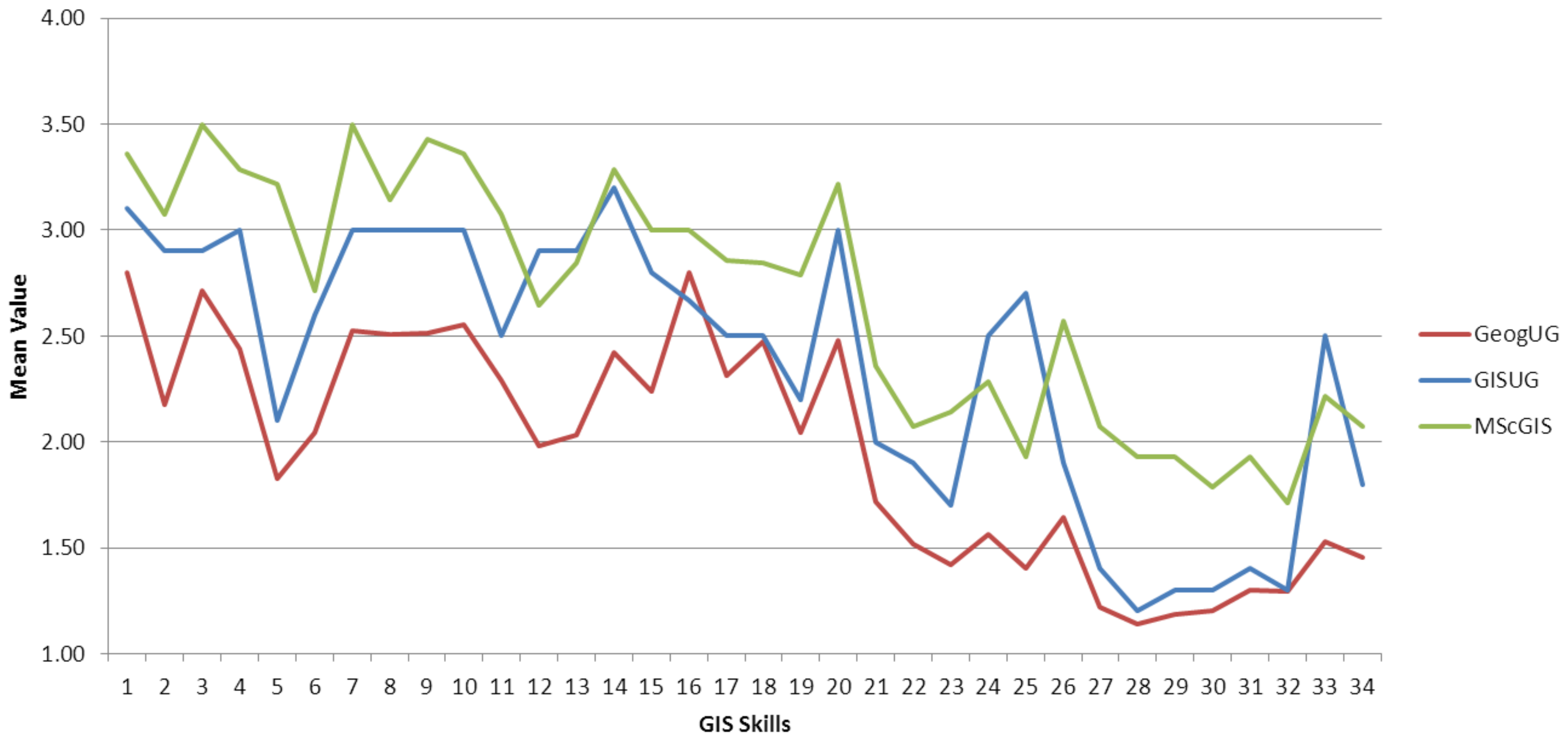


Figure 8.7: A comparison between the views of Geography UG and specialist degree programme students on their GIS skills

Note 1: A score of 1.00 means that students say they have no experience in this GIS skills area. The top value of 4.00 means that students rate their competence at ‘advanced’.

Note 2: The above information is presented in graphical form, because there is a gradient, moving from left to right, from the relatively “easy” skills (with low numbers) towards the more “difficult/complex” skills (with high numbers).

Students' career aspirations in GIS

All the students in the survey were asked whether they were looking for a career in GIS, with their comments classified as 'Yes', 'No' or 'Don't know'. As can be seen in Figure 8.8, the majority of Geography students opted for the 'Don't know' category (54%). This means that they were still undecided about whether they are interested in a career in GIS or not. However, as illustrated by the work of Gedye et al. (2004) it is very common for Geography undergraduates to be uncertain about their career plans and it is perhaps encouraging that some 30% of the survey students were at least considering a GIS-related career (although GIS-related careers come in different types, see section 8.4.1). Several Geographers seem to be considering jobs in fields which may occasionally use GIS. For instance:

> GIS skills are emerging as a particularly essential set of skills in many aspects of career-planning etc (GUG106, CSD1).
>
> My career aim includes doing research on site selection for retailers, because it is interesting and this area is of importance in the GIS job market. (GUG109, CSD1).
>
> I'm hoping to find employment based around hydrology, and water management and therefore GIS would be useful (GUG65, CSD3).

In addition to this, a few Geography students already recognized the importance of having GIS skills while doing a placement:

> I did a placement as a transport planner and GIS was very useful (GUG80, CSD3).

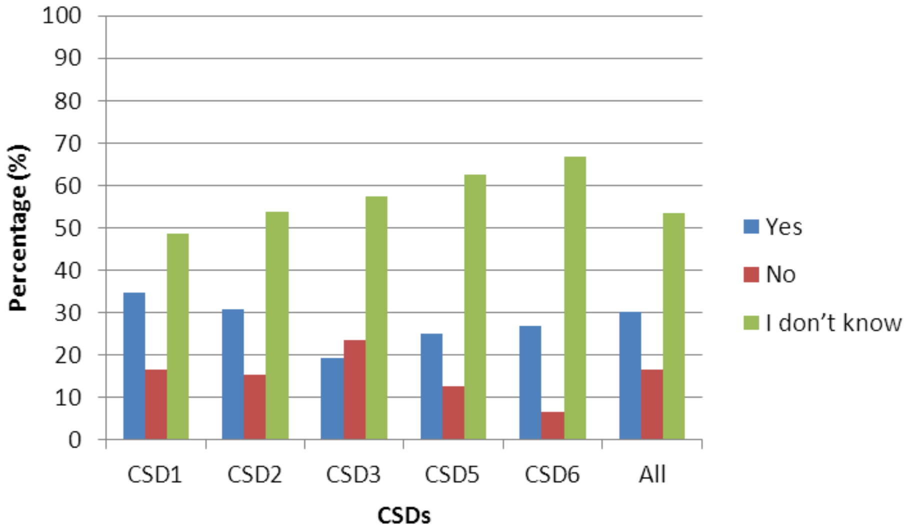


Figure 8.8: UG Geography GIS students' views on their career aspirations in GIS

Unlike Geography, students on the GIS degree programmes typically had career plans much more focused on GIS (Figure 8.9), as one would expect. In this case, no less than 75 percent of students (mean for the two specialist degree programmes) were looking for a GIS-related job, as illustrated by the quotes below:

> I have always wanted to use GIS in my career and I have been offered a job which I do not think I would have got if it wasn't for my MSc in GIS (MSc28, CSD1).
>
> It will help me to move jobs within the GIS area (MSc13, CSD2).
>
> Web GIS is a new area and there is more demand as end users become more familiar with seeing and interpreting information in a pictorial yet spatial context (MSc26, CSD1).
>
> I hope to move into a career where I can further advance my GIS skills (GISUG6, CSD4).

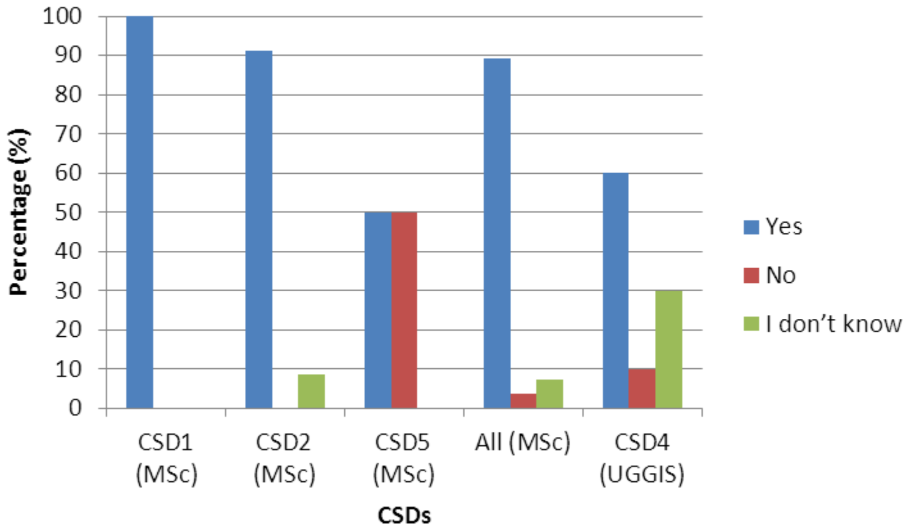


Figure 8.9: Specialist GIS degree programme students' views on their future career aspirations in GIS

By contrast, 16% of the undergraduate Geographers definitely do not want a career pathway involving GIS: they underlined that GIS is too difficult and complex or that they are interested in a particular profession which does not involve GIS. There was also a recognisation among the UG Geographers that their GIS expertise might be insufficient for a career in this field, or that they did not know enough about it.

> GIS may be a career path but I have not had enough experience yet to really consider it (GUG53, CSD3).

Overall, students' views on employability and their careers suggest that there is a big gap between the opinions of Geography students and those on the GIS courses. While this was to be expected, what had not been anticipated was the extent to which even a few of the Masters students felt lacking in some of the more advanced GIS skills, which could be useful vocationally.

8.2.2 GIS lecturers' perspectives

Having discussed the views of students on skills, employability and careers, now this chapter gives attention to the views of GIS lecturers (GISLs) and programme coordinators (PCs). Naturally, all the staff thought that GIS offers employability potential for graduates, and not only in organizations whose key role is in GIS. As one of them asserted:

> Many students go onto jobs where GIS is used, such as in Environmental Consultancy, Chartered Surveying, and Land Management, all those kinds of job where they use GIS. I think it is useful for lots of students to at least have had some exposure to GIS (GISL4, CSD3).

However, the majority of staff agree that the current economic recession is affecting the numbers of posts available. Additionally, some of the Geography GISLs suggested that although GIS skills gained through a GIS module would be useful, having an MSc degree in GIS would open many more opportunities, an opinion also supported by Unwin (personal correspondence, May 13th, 2010). In the words of one lecturer:

> Undertaking a large-scale project using GIS (e.g. a whole Masters dissertation) increases competitiveness in the job market. These students can prove hands-on skills more than an undergraduate student who has taken a single module. (GISL5, CSD5).

However, one of the GISLs also argued that the job type is one of the main determinant factors as to whether students have enough GIS skills; “because there are many types of jobs demanding different skill sets” (GISL1, CSD2). Nevertheless, all the GISLs believe that a good understanding of GIS and some fundamental GIS skills are among the main things that Geographers should gain during their undergraduate programme. So, although Geographers obviously are not GIS specialists, the staff’s aim is to equip them with at least basic GIS skills and provide them with a fundamental understanding of GIS concepts so that they can later acquire new skills when they are employed through in-house training.

The GISLs argued that their GIS teaching does also include a focus on improving certain types of transferable skills. Almost all of them agree that problem solving is the most important skill; however, time management, report writing, and IT literacy are also important skills on which they wanted to concentrate. In addition to this, they would ideally wish also to improve other skills, but they think that the module time is not enough to do this, and that other modules within the programme will cover the skills they do not. As mentioned in the previous section, one of the GISLs echoed the difficulties the assessment pattern creates for the improvement of team working skills, given that individual marks are needed. Generally the GISLs showed little awareness of the methods which are available to produce individual marks from team exercises (Knight 2004, Livingstone and Lynch 2002, Maguire and Edmondson 2001, Smith et al. 2012).

Regarding PCs' views, they tend to think that one of the most important skills they wish to emphasise is 'research skills' particularly in the case of MSc programmes. However, two Masters PCs also underlined that one of the main assets they would like students to gain is an awareness of the commercial world including skills such as project management:

> One Masters module was designed for students to manage a project within the workplace that makes use of GIS. It was anticipated that our MSc students would not usually be the technical analyst but would be able to call on support from one or more technical GIS experts (PC4, CSD5).

However, when looking at the situation in module handbooks and programme specifications, transferable skills were not prominent (and sometimes had a low profile) within the content of the ILOs and curriculum of the GIS degree programmes. The great majority of ILOs focused on GIS-related knowledge and skills, although the interview evidence showed that the staff do have an appreciation of the importance of transferable skills. The specialist UG GIS programme (CSD4) was better at having ILOs on transferable skills.

The GISLs' views on students' transferable skills development were broadly similar to those of the students themselves. Specifically, problem solving and critical thinking were among the main skills emphasised by the GISLs. In addition, their opinions also aligned with the results of ESRI's UK survey (2011) which also indicated that GIS employers value 'understanding and interpreting complex data' (71 percent of 200 participants), 'advanced technological skills' (57 percent) and an 'understanding of socio-economic environments' (54 percent). An RGS with IBG report (2011) claimed that all these skills are already offered by Geography programmes. While this may be true, it is important, however, to recognize that most Geography students do not take a GIS module (which are typically optional) and so this may well limit the number of geographers who in practice actually do possess advanced technological skills and the capacity to handle complex data sets. What it is offered and available within the curriculum is not the same as what is actually chosen by students.

Regarding their graduates' employment rate in the GIS job market, the Geography GISLs were asked to provide a rough number or percentage. Information of this kind is increasingly important because the recent Higher Education White Paper (BIS 2011) makes clear that departments should provide public information about their graduates' job destinations. However, when asked, none of the Geography GISLs or PCs were able to provide figures on the numbers of students going into GIS jobs. Nonetheless, those who had a rough idea said that only a small proportion (perhaps 10-15 percent) of those who studied GIS went into a job requiring GIS skills.

However, PCs for the specialist GIS programmes believe that the majority of their graduates are employed in the GIS market after graduation. Additionally, they also stressed that some of their students are already in a GIS position – sometimes part-time – during the period of their study (particularly in the case of MSc programmes).

Regarding the issue of their relationship with employers and their alumni, the majority of GISLs asserted that they did not have a formal departmental system for collecting information about their former graduates, but they believe that the institutional alumni office does try to collect this information. Normally the institution's careers service will collect data on last years' graduates. In the future most University degree programmes will be required to make public their first destination (DLHE) data in order to help inform the course selection process of prospective students. This will mean that careers and employability information is becoming a more important part of the student recruitment process, not only because of increased fees but also because of the increased public availability of careers data.

Although departmentally-initiated contacts with former students (particularly those from a few years ago) seemed very patchy and unsystematic, two GISLs indicated that from time to time their departments conduct alumni surveys, particularly for the reason of informing the up-dating of the programme design and curriculum.

> I don't get regular feedback from old students; I occasionally came across them for some reason as part of my other duties, but certainly not from GIS employers (GISL4, CSD3).

Amongst those staff who are getting feedback both from students and employers, GISL1 implied that from what he hears most students are happy with the skills they had learned from their GIS module. Occasionally he has some feedback, suggesting, for example "Why you didn't teach us SQL or Oracle, because it is all I am doing now?" However, he believes that these kinds of comments are very specific and that he cannot cover all of these kinds of demands within a single GIS module.

As for relationships with employers, the majority of GISLs have little or no regular contact with GIS employers (even those involved with the specialist GIS programmes). One of the GISLs underlined that he has contact with local governmental organizations and the main feedback he received was that their students' writing skills were rather disappointing, and so this is why he has been placing a greater emphasis on report writing skills. As he says:

> What we hear occasionally is that technology skills are increasing but they still want them to write a report in decent English. That is the reason why we are hugely insistent that our students do dissertations and projects (GISL1, CSD1).

Overall, GISLs think that the former students tend to fully realize the importance of what they have learned only when they become involved into the real job tasks. However, the impression gained is that GISLs generally have only limited contact with former students and with employers. Presumably, the pressure on staff is such that it is difficult for them to maintain these external contacts when faced with the immediate pressures of day-to-day academic life, such as teaching, marking and publishing.

8.3 Views from Employers

Having provided staff and student views in previous sections, the focus in this section now moves to another key stakeholder group, namely GIS employers (GISEMs). In addition to employers' views about the issue of employability (the main GIS skills needs, the requirements of GIS-related jobs and the future of the GIS job market), a review of over 350 job advertisements is also provided in order to provide the basis for a discussion of the different kinds of GIS jobs in the market and the skills they require.

8.3.1 GIS employers' views

In order to obtain employer views, four GISEMs' questionnaires were completed and two interviews with GISEMs conducted (see Table 8.2). Although it had been hoped to benefit from the views of a larger number of GIS employers (16 were on the original list), they proved a somewhat elusive group with a reluctance to respond to e-mails or to put aside time for interviews. In the end, information was obtained from six organisations (five from the private sector), four through questionnaires and two through interviews (one by telephone and one face to face). Similar questions were asked of all participants (see Appendix 5). The initial target list of 16 was drawn up through seeking advice from relevant senior academics such as Emeritus Prof. David Unwin and the chair of the RGS-IBG GIScience Research Group, Prof. Muki Haklay. Although the response rate was disappointing, this was offset by the calibre of those who were involved-all were in senior positions, had a good knowledge of the GIS labour market and provided helpful replies.

Table 8.2: GIS Employer participants in the GIS market

GIS Employers	Position/Company Type	Data Collection Method
GISEM1	Software Company/Development Managers	Face-to-face Interview
GISEM2	Consultancy/Director	Phone Interview
GISEM3	Service Provider/ Director of Sales	Online Questionnaire
GISEM4	Data Provider/Research Manager	Online Questionnaire
GISEM5	Data Provider / Principal Data Scientist	Online Questionnaire
GISEM6	Software Company/ Community Programmes Manager	Online Questionnaire

The six participants all had substantial personal experience of working in the GIS field. Two were from major GIS software companies, one was from a consultancy company, two were from data supplier organisations (including one from a key government agency), with the remaining one from a private sector service provider company. However, the key common feature across all the participants is that they hold posts at managerial level. As a result they take part in the recruitment process and preparing of the organization's employment policy.

The organizations vary considerably in terms of employee numbers. The smallest has only five staff, but with the remaining organisations sized between 100 and 1300 employees. Their ratio of GIS specialists to other employees ranges from 10 percent (data supplier company) to 50 percent (GIS software company). Additionally, they stated that a very low percentage of their employees (max. 10 percent) are working in short-term or fixed-term contract positions. This indicates that particularly the large GIS organizations prefer to recruit on a permanent basis. They also confirmed that at least 50 percent of all their specialist GIS employees have Geography (or closely related) degrees, and that the numbers of GIS degree holders (either undergraduate or postgraduate) is very much smaller. However, it should be borne in mind that the proportion of Geographers within particular fields can be lower (e.g. the development team consists mainly of programmers and computer engineers and the marketing team has mainly people from a business background).

When they were asked about their relationships with HE institutions, their responses showed that there are three kinds of collaboration or support: a) sponsorship for postgraduate projects at Masters and occasionally PhD level; b) sponsorship for academic-related activities (e.g. conferences, careers days); and c) contributions to teaching (running joint training programmes or being a guest lecturer on a Masters programme). The institutions with which they have closest collaboration seem to be universities with GIS Masters. The variety of forms of contact is illustrated below:

> We have a CHEST agreement through Eduserv and deal with approx. 142 universities and further education institutions. We have good relationships with many of these sites. We have part sponsored a PhD at X, supported Masters Projects at Y, have sponsored prizes at Z and W and attend various

> HE events including GISRUK. We have also given talks when asked to A and B institutions (GISEM6).

With respect to the degree qualifications for which the survey organizations are looking, they tend to say that a good first degree (typically in Geography with some GIS teaching) generally meets their expectations, but occasionally the need for some specific and advanced skills could require them to hire graduates with an MSc degree. For example, fewer undergraduates would have experience of GIS programming and databases (GISEM4). This indicates the advantage of having an MSc degree in GIS and/or the relevant experience with more advanced levels of GIS skills.

Having previously discussed the issue of teaching theory versus practice (see section 5.3), the employer survey revealed a number of views about this tension. For instance, one of the employers emphasised that their company values experience of practical application of GI theories using actual data rather than purely theoretical knowledge (GISEM5). Although this view supports the importance of application-based GIS education, other GISEMs supported the importance of a background in theory: "It is fundamental to the business that the staff working on the project have some core theoretical knowledge of the environment they are working in" (GISEM3). This issue seems to be a matter of balance; it is, however, clear that a theoretical understanding of GIS and related subjects can help in terms of employability. This also supports the results of the Geography alumni survey conducted by Whyatt and colleagues (2011).

GIS skills and specialisations

GIS employers were asked what skills and specialisation areas are the most important for recently graduated students who are looking for a job in GIS. The majority answered that the skills and specialisation areas can vary both within and between organizations. Nevertheless, their opinions underlined that alongside a general understanding of GIS technologies and how to use GIS software, they are looking for some specific skills related to trends in the job market such as Coding, Spatial Database Management (e.g. Oracle), Remote Sensing, Surveying, System and Software development and Web-based GIS (e.g. smart-phone applications).

For instance, GISEM1 emphasised that although Masters degree providers deliver a wide range of GIS and complementary skills for the job market, there is still a disconnection between academia and what the business world needs. In his words:

> I know there is a different world in academia. I don't think that they are tuned enough to business needs. I think that some areas could be covered a lot more. For example, what is important for business at the moment is to develop spatial applications on smart phones; it could be done by any of the universities (GISEM1).

Although complex and advanced GIS skills have become important in the GIS job market, at the same time, particularly in the consultancy companies, research skills such as data collection (interviewing, designing surveys and reporting etc.) can also be very valuable. In the words of one consultant manager:

> The most important skill the person should possess is a level of research skills which enables them to collect the necessary information from the field and make sense this data according to business needs (GISEM2).

Overall, the GISEMs identified that increasingly the software development part has become challenging for Geographers who do not have these kinds of technical skills and mostly this requirement is filled up by Computer Engineers. This reinforces the work of Brown (2004, p.19) who found that the "software programming abilities" and "database management" were becoming vital skills for GIS recruiters.

Jobs and skills trends in the GIS job market

When asked to comment on the trend in the number of GIS posts, of the six organizations three predicted a moderate increase, two anticipated little or no change and one expected a moderate decrease. All considered the current economic climate to be a restraining factor.

> As you know, the market is quite difficult at the moment (GISEM2).
>
> Expansion is only moderate due to current economic restrictions (GISEM4).

However, one of the GISEMs also asserted a further factor, namely job saturation in the company:

> We have reached a stable level of posts and really only recruit to replace individuals who move on. On-going technical advancement and a continued focus on efficient and effective working practices mean that we can grow the business without the need for additional recruitment (GISEM5).

With reference to the GISEMs' answers on national trends and changing GIS skills requirements, their responses for the national job market were generally similar to trends in their own organizations. However, one of the participants summarized the situation in the job market during the last few years as follows:

> In 2006-2007, the market saw substantial growth, but since then there has been a moderate decline, particularly because of government spending cuts. This has particularly affected local governmental organizations (GISEM2).

Their opinions also underlined changing trends in skills requirements. The majority of answers showed that coding, web and mobile technologies, and database management are the current skills in demand. For instance:

> The skills trend is changing from Desktop GIS, and moving towards open source, and proprietary internet platforms such as BING and Google (GISEM5).

There was a consensus that "a greater in-depth understanding of programming, databases and web 2.0" (GISEM4) is becoming more important in addition to mainstream GIS skills. Whereas Willis and Nutter (1990, p.301) found that “writing algorithm for GIS software” was in the late 1980s the least demanded skill, today, this skill seems to be one of the most desirable in the GIS job market. However, it should also be acknowledged that the number of participants in this study is rather small to generalize safely across the GIS labour market as a whole.

Concerning transferable skills, a mix of such generic skills was identified by the GISEMs including: verbal and written communication skills, awareness of business and marketing, time management, leadership, interpersonal skills, project management, and team-working. These skills are basically similar to those considered important by the academics and the students but employers attach more importance to business awareness and marketing than is common in academics. Regarding team-working skills, particularly GISEM1 underlined that:

> You need people with understanding, who have communication skills and team-building skills, and team leadership skills; these are crucial soft skills really to have a more successful company.

Future trends in the GIS job market

The majority of participants agree that the future expectation in the job market is towards moderate growth or stability; in addition, GISEM2 underlined that more jobs will be offered by small companies which are starting to occupy a larger place in the job market. However, these kinds of companies commonly work on project-based business, and so their employment strategy will more often use short-term or fixed-term contracts.

Turning attention to future skills in demand, almost all of the participants agree that once again, designing smart phone applications, customizing software platforms, database management (spatial databases) and web 2.0 will be dominant skills in the job market during the next five years. This is partly because the government's open-data policy on spatial and socio-economic data provision is leading the market towards Open-sources software and data sources.

Regarding the direction in which sectors will be going, Coote and Rackham 2008 (p.27) report that "consumer location-based services" will be an area of growth, but "it is likely to benefit only a relatively small number of big players and some innovative start-ups". This view was confirmed by GISEM2. However, ESRI's foresight report (2010) showed that almost every single segment from governmental organizations to private sector companies is expected to grow in relation to spatial data and services. So, they believe that the need for skills such as collecting and managing complex geographic data, product spatial analysis and data interpretation are the skills which will be in demand. This might be an advantage for Geographers, because they generally possess spatial analysis skills in addition to a wide range of broader transferable skills.

The question asking about the overall satisfaction of GISEMs with UK Higher Education prompted three different opinions; Satisfied (3), Neutral (2) and Dissatisfied (1). Those expressing satisfaction indicated that they are generally happy with both the technical and the transferable skills which graduates possess. However, some of GISEMs expressed concerns about the relationship between academia and the business world. They said the level of interaction and collaboration, particularly in the case of Geography departments, is too low, and that students need more exposure to the world of work and more business and commercial awareness.

8.3.2 Review of GIS job advertisements

Having discussed the employers' views, the last part of this section provides an examination of GIS job advertisements during the 12 month period from September 2010 to August 2011. A total of 402 job ads were collected from two different job advertisement agencies (Geographyjobs.co.uk and GISjobs.co.uk) and from one JISC network dedicated to GIS jobs (GIS-jobs@jiscmail.ac.uk). After a detailed examination of various web-sites and their relationship with GIS-related jobs, these three were considered to be the main relevant sources. In the data collection process, I presented myself as a job seeker in the field of GIS. This enabled me to monitor any job ads coming to my e-mail address. The main aims were to find out what types of jobs are available and what kinds of skills requirements are proposed for these jobs. However, it is important to note that the data collected from these three sources obviously does not cover all GIS jobs in the labour market. Although it is almost impossible to specify exactly the full total of GIS jobs available, the web-site entitled itjobswatch.co.uk identified 329 GIS-related jobs for a three month period in 2011 and so the annual UK total is probably in the order of 1000-1400.

As can be seen in Table 8.3, three types of jobs emerged from the review of job ads. The boundaries between each category could occasionally be blurred but the majority of the advertised posts fell clearly into one of three groups. The first type (type-1) related to jobs requiring basic or rudimentary GIS expertise. This type of job is typically advertised as a Planning technician, Environmental Policy Officer etc. Of 402 job ads, some 15 percent can be placed in this category. These types of jobs are open to competition from other disciplines outside of Geography and are not specifically or exclusively targeted at Geographers. Nonetheless, the jobs categorized underneath this heading seem to be the most attractive ones for UG

Geography students who might want to go into a career involving some GIS-oriented work. This type of job might, for example, be advertised by a local governmental organization. The posts require some basic GIS expertise but GIS is not the jobs' main role or title.

Table 8.3: GIS job typology

Job Types	Typical Requirements	Typical Transferable Skills	Expected Degree Subject
Type-1 GIS-supported job (e.g. Planning technician, Environmental Policy Officer Land Charges Officer, EIA Consultant)	• Some knowledge of planning • Ability to use GIS (e.g. spatial analysis skills), • Ability to use MS Office Packages • Data inputting	Communication Team-working Research skills	Archaeology Biology Geography History Planning
Type-2 GIS Researcher, GIS Officer, GIS Consultant, Location Planning & Market Analysis Consultant	• Geographical Information background with basic or medium level spatial analysis skills (e.g. suitability analysis, site selection) • Familiarity with socio-economic data. • Interpreting Geographical data • Analysing Geospatial data	Communication Team-working Project Management Reporting skills Marketing skills Business development skills Leadership skills Time Management Research skills	Geography GIS Masters GIS
Type-3 GIS technician, Analyst/Developer/Web Developer/ Engineer/Application Developer, GIS Specialist etc.	• Programmeming languages • Web-based GIS • Database Management • Mobile application	Problem solving Team working Presentation Report writing Data analysis Keeping up to date with changes in GIS technology	Geomatics Computer Engineering GIS UG Masters GIS

The second type of job (e.g. GIS Officer, Location Planning, etc.) also seems to be well suited for Geography graduates with a GIS background, not least because Geography students are familiar with such areas as socio-economic data and their representation and analysis. However, as mentioned earlier, business and marketing backgrounds have also become competitors in this type of job (see Shepherd 2009), because general business skills are often seen as important. Nevertheless, it should also be acknowledged that there can be a grey boundary between type-1 and type-2 jobs, with the latter having a stronger focus in GIS. Type-2 posts are most commonly associated with, retailers, spatial service providers and local government.

Type-3 is GIS specialist jobs that require advanced levels of GIS skills (e.g. different types of programming language and database knowledge). This is the most demanding job in the current market and just over half of all posts fall into this category. As emphasised by GIS employers, these types of job are increasing in the GIS job market, but as one of the GIS employers underlined, Computer Science and Geomatics degree graduates are serious competitors to Geographers in this area, a point also made by Longley (2000).

Regarding the issue of the balance between supply (the number of GIS jobs available) and demand (the number of interested and qualified graduates), It is obviously extremely difficult to quantify the current situation. What can be said, however, is firstly that employers always like there being a strong demand for their posts because this enables them to appoint very good candidates. And secondly that although the employers interviewed did not complain that it was regularly very difficult to find graduates who were reasonably qualified for advertised posts, there were exceptions. Where serious recruitment problems occurred it was most commonly in the newly emerging fields such as mobile GIS technologies, programming in desktop GIS and web-based GIS.

Overall, when taking employers' views and the review of GIS job ads both into consideration, it seems that jobs requiring GIS skills at a basic or moderate level (such as town planning) are very suitable for current Geography graduates. However, some Geographers might also be employed in GIS specialist jobs even if they do not have advanced programming skills. This is because Geographers' spatial-literacy and cartographic backgrounds are much stronger and their technical skills can be upgraded by offering in-house training. Overall, it can be concluded in the words of GISEM3 that:

> Individuals who are technically adept and know the core geography skills are always going to do better if they are also able to present well, talk eloquently, be able to deliver reasoned argument and manage their time and perhaps other people.

Many employers would ideally like to recruit graduates with both the technical and the 'soft' skills needed, but in the course of the research interviews, the employers tended to acknowledge that upgrading technical skills can be easier than developing skills of a more social or personal nature.

8.4 Synopsis and Evaluation

In this chapter, the views of students, lecturers and employers have been brought together to provide insights into the issue of GIS and employment. This is an important topic not least because almost all students enrolling for the Masters programmes did so to improve their job and career prospects. Moreover, even most of the UG geographers chose the GIS module because they believed it would enhance their employability.

For the Geography students the surveys show clear evidence that most feel their mainstream GIS skills have generally reached the point where they know the basics or are moderately skilled. They therefore feel essentially familiar and comfortable with areas such as software tools, using national data sets, managing spatial data and techniques such as buffer zone and intersection analysis. However, very few of the Geographers claimed any experience of more advanced techniques such as script process tools, setting up on-line data base or creating a web-based GIS application. Although the results for students in the UG GIS programme were not radically different, they did generally feel more confident about both the basic and also the more advanced skills (though in the latter group there were still some areas where most students claimed no experience). Taken as a whole, it was not surprisingly, the Masters students who gave the most positive evaluation of their GIS skills across the range from mainstream to advanced/specialist areas, thereby clearly placing them at an advantage in the GIS job market. However, this advantage was less evident with reference to general transferable skills, which employers also value and look for, and which one might have expected to have been more prominent in the Masters programmes given the general vocational-orientation of much Masters-level teaching in the UK. The survey results tend to suggest therefore that the Masters GIS programmes were more effective in terms of their technical education than their development of transferable skills (despite such skills including business awareness often being crucial for employment).

An analysis of advertised posts in the GIS field led to a three-fold classification of posts. Type-1 (15%) is jobs (such as Planning Technician) which require basic GIS skills simply as part of a wider role. Type-2 (30%) is jobs (such as a GIS officer in a local authority) which require basic or medium-level GIS skills plus an ability to analyse and interpret socio-economic data. Type-3 (55%) is jobs (such as a GIS analyst or application developer) which require advanced GIS skills. Type-1 and 2 could be suitable for Geographers who have taken a GIS option, but type-3 is likely to demand a degree (undergraduate or Masters) in GIS and could also be open to competition from graduates in areas such as Geomatics and Computer Engineering. Given that at least half of all GIS jobs are type-3, this raises the question of whether Geography programmes should offer opportunities to study more advanced GIS skills, as is the case in the USA (see Prager and Plewe 2009). This issue was also identified by Whyatt et al. (2011) in their study of UK Geography alumni.

Although the limited number of employers contacted in the present study had a variety of views on the quality of HE's GIS provision, three ideas came across clearly and consistently. The first is that there is a growing demand for skills in areas such as web programming, desk-top coding and open-source software. The second is that, as the ESRI (2010) survey identified, it is important for GIS professionals to have not only good transferable skills but also at least a basic understanding of business and marketing. And thirdly, that in the GIS field the pace of change is such that it is very important for there to be a strong relationship between employers and HEIs. A number of Confederation of British Industry (CBI) reports (2009, 2010 and 2011) have argued this linkage point generally and it was certainly reinforced by the employers in the present study. Moreover, my interviews with GIS academics suggest that links between GIS lecturers and relevant external companies and organization (and alumni) are at present generally patchy and not strongly developed.

In reflecting on the significance of the three key messages identified above, it is particularly important that Geographers and Geography departments respond. In part this is because employability is becoming a still more crucial issue but also because in a period of austerity, there will be strong competition for graduate jobs. Moreover, GIS is a sector with long-term growth prospects and an area of opportunity in which geographers should have a natural advantage.

CHAPTER 9 : GEOGRAPHY-BASED GIS EDUCATION IN TURKEY

9.1 Introduction

This chapter provides a broad analysis of the main issues related to the Turkish part of this PhD thesis. The chapter begins with a discussion of the Turkish HE system and of Geography's position within it: this mirrors the UK discussion in chapter 2 (see sections 2.1 and 2.2) and presents a scene for the Turkish results sections which follow later in this chapter. In chapters 5-8, GIS education in the UK CSDs was reviewed with respect to provision, pedagogy and employability. Now in this chapter, similar aspects of the Turkish CSDs are examined: however, this chapter is a shorter version and only the main findings are considered. This briefer approach is justified partly by the need to keep the thesis length close to University regulations, partly because many of the key generic issues have been introduced earlier and partly because an important focus for this Turkish chapter is simply on points of comparison with the UK.

The Turkish evidence (as for the UK) rests on data collected from questionnaires, interviews, observations and documentation (in this case, particularly ECTS forms). After setting out the context in sections 9.2 and 9.3, the results sections deal in turn with GIS provision (9.4), with GIS pedagogy, focussing on staff and students' views (9.5 and 9.6) and on employability (9.7). The chapter closes with a section (9.8) which provides a summary and evaluation, highlighting especially points of comparison between the UK and Turkey.

9.2 The Growth and Changing Face of Turkish Higher Education

Turkey's HE system differs from that in the UK, because it has been more affected by political and economical upheavals such as Turkey's 1950s financial crises, the

1968 student movements, various social conflicts (such as strike actions) in the 1970s and 1980s and military coups in 1960 and 1981. Greater autonomy was given to Universities following the 1960 military coup and the 1961 constitution. The establishment of HECoT (Higher Education Council of Turkey) followed the 1981 military coup and new 1981 Constitution. So, the development of HE has been highly affected by changes in the political scene of the country (Kondakci and Yildirim 2004, Mizikaci 2003, Tas 2005, Timur 2000).

The establishment of modern HEIs in Turkey dates back to the early years of the Republic of Turkey (which began in 1923), much later than in many western countries. Although the origins of Istanbul's universities can be traced back to the 17th century (Darülfünun-u Sultani in Ottoman Empire times), Istanbul University and Istanbul Technical University, set up in the 1930s, were officially the first universities to be established in Turkey. Ankara University became the third university to be opened under the Turkish Republic in 1935. By the end of the 1950s, the total number of universities was seven and the figure had reached nineteen by the start of the 1980s. Then the establishment of HECoT began a period of major expansion and change. There were 24 new Universities established in the early 1990s, most of which had previously been part of other HEIs but in 1992, law no. 3837 allowed them to become separate universities and to open new schools and faculties within their own structure.

By 2003 the total number of Turkish HEIs had reached 165, including the non-profit foundation universities (private universities). And by the end of 2010, the figure was 171 (HECoT 2010). Figure 9.1 provides a map showing their spatial distribution. It illustrates, for example, that in recent years the government has encouraged the establishment of a large number of HEIs in the east of the country which traditionally has been poorer and with fewer HE places. The overall picture of HE expansion is related, of course, to Turkey's rapid economic and industrial expansion and its need to ensure that its population (74 millions) has the skills to continue the country's economic progress.

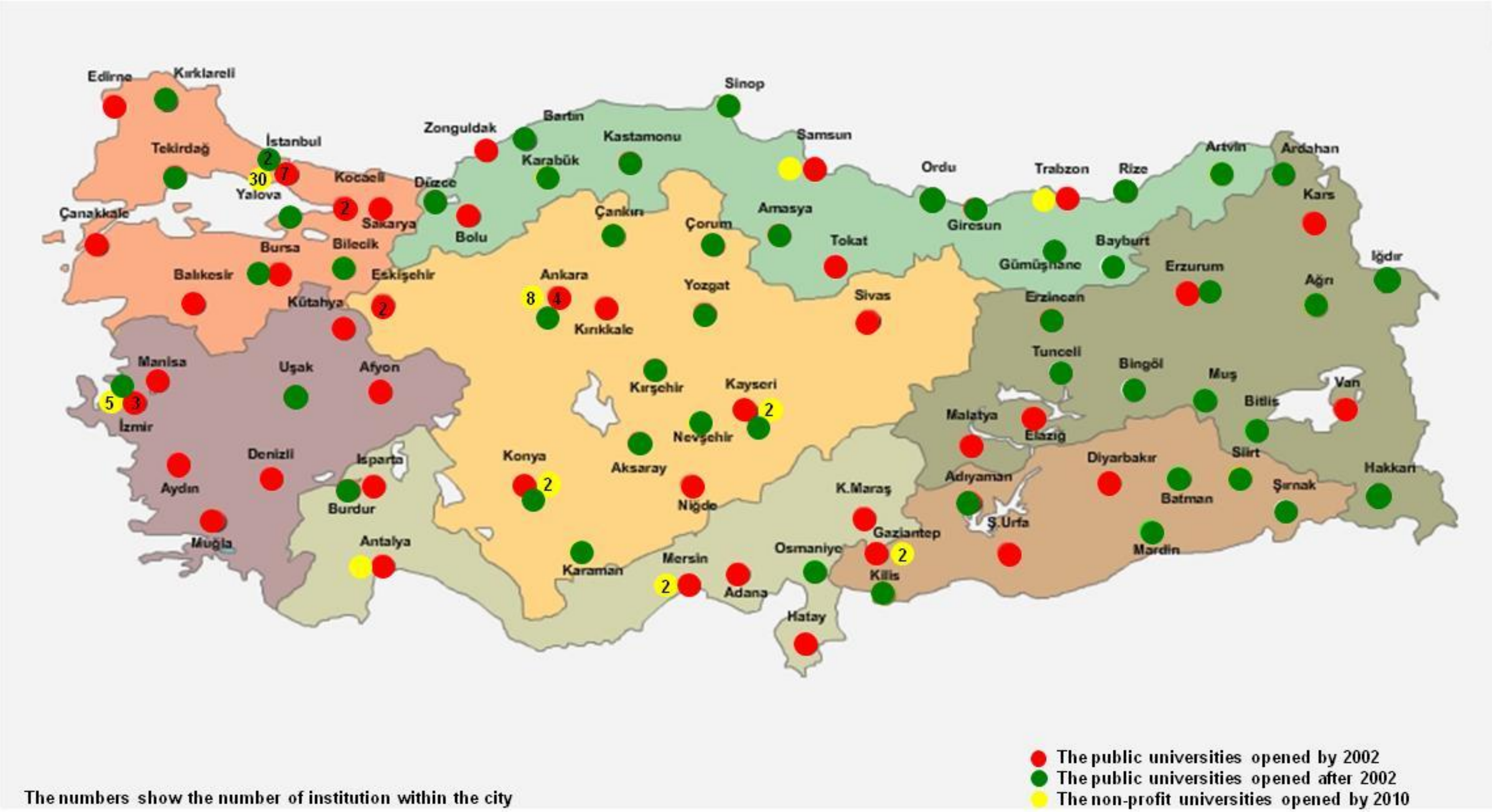


Figure 9.1: The distribution of Higher Education Institutions in Turkey (by 2010) (Source: The map is adapted from the Higher Education branch of the Ministry of Education-MoE (2010)

In Turkey, one of the differences from the UK is the existence of non-profit (private) universities, as well as publicly funded (state) universities. By 2011, there were 60 non-profit HEIs (HECoT 2011). The private universities have been funded by charitable foundations and by the fees paid by students. There is no cap on their tuition fees which can be increased according to the decision of each governing body of the institution. There are two main differences between public and private universities. The first is that tuition fees are much higher in private than state universities (respectively £6000-£11000; £150-£800 per annum). The second is that although students have to take a state-level university entrance exam to go to private universities, their point requirements are lower than for the equivalent programme within the state sector.

Another important difference from the UK is that in Turkey, universities include some schools focussing on vocationally-oriented pre-degree programmes (HECoT 2010). The vast majority are technical courses whose graduates obtain professional qualifications called "Associate Degrees", these are somewhat similar to the UK's Foundation Degrees. There are no Associate Degrees in Geography. Therefore, within Turkish universities, there are three different types of programme: one is Associate Degrees lasting two or three years; the second is full undergraduate degree programmes ranging from four years to six years[15]; the third is postgraduate degree programmes (Masters and PhDs) (HECoT 2010).

Given the huge expansion in the number of universities, the total number of students (including Associate Degree students) in Turkish HEIs has also substantially increased.

[15]Apart from Medicine (six years) and teacher training programmes for secondary school education (five years), almost all first degree subjects last four-years. Additionally, Master level degree programmes are two years and PhD programmes four years. Associate degree programmes normally take two years.

As seen in Figure 9.2, since the 1980s there has been a consistently upward trend. Additionally, the HE participation rate has increased from 10.25% in 1997 to 33.06% in 2011 (TUIK 2011). However, this rate is still a little way behind many western countries (46% in the UK).

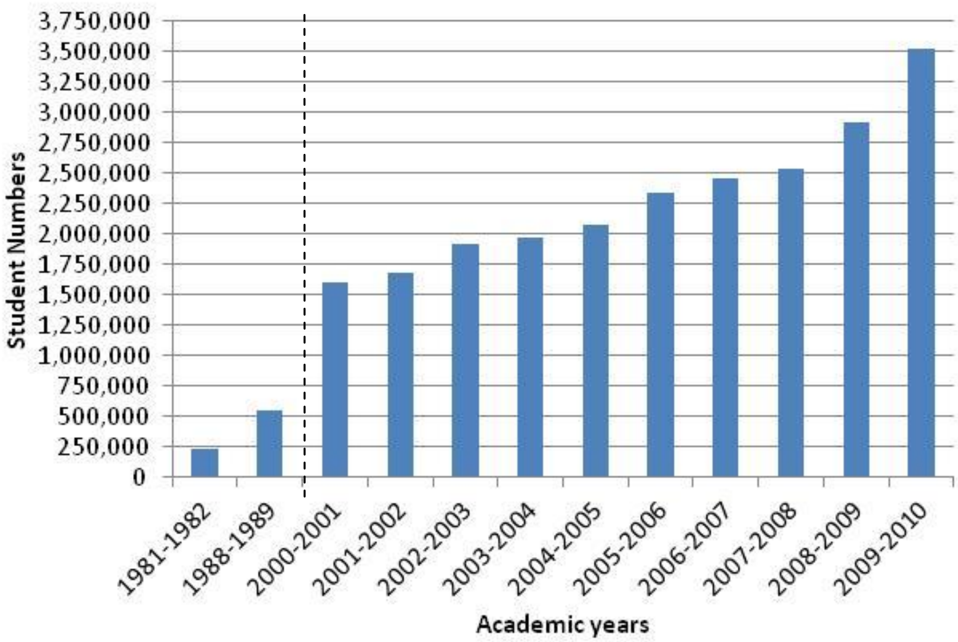


Figure 9.2: The total number of HE students in Turkish HEIs
(Source: OSYM, 1982, 1989, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010b)

Unfortunately, the growth in student numbers has not been matched by a similar growth in the numbers of academic staff. This has resulted in a deterioration in the ratio of students to staff. Although student/staff ratio in the UK is currently about 18:1, in Turkey it is 53:1, though if all academics are counted (including those entirely engaged in research) the ratio is 33:1 (Table 9.1). Broadly speaking, these kinds of ratios also apply within Geography departments (see the section 9.3).

Table 9.1: Total number of HE Students and Academic Staff in Turkish HEIs during the period 1999-2010

Academic year	Total HE	Total Teaching Staff	Total Academic Staff	Student/T.Staff Ratio	Student/A.Staff Ratio
2000-2001	1.607.388	39990	67880	40,19	23,68
2001-2002	1.677.936	43017	71290	39,01	23,54
2002-2003	1.918.483	46271	76090	41,46	25,21
2003-2004	1.972.662	48033	78804	41,07	25,03
2004-2005	2.073.428	51326	82096	40,40	25,26
2005-2006	2.342.898	53394	84785	43,88	27,63
2006-2007	2.453.664	55867	89329	43,92	27,47
2007-2008	2.532.622	60819	98766	41,64	25,64
2008-2009	2.924.281	62632	100504	46,69	29,10
2009-2010	3.529.334	66427	105427	53,13	33,48

Source: OSYM (2000; 2010)

Another important difference from the UK is Turkey's greater emphasis on second education ('dual') programmes (at both pre-degree and degree level), which are designed principally for mature students who have a full-time job and are delivered in the evenings (Dundar and Lewis 1999). This type of programme (which includes some Geography provision) allows Universities and academics to earn more money and accommodates students with lower entrance exam scores. As seen in Figure 9.3, students in second education programmes account for 25 percent in Associate Degree programmes and 11% at Undergraduate level (Figure 9.3).

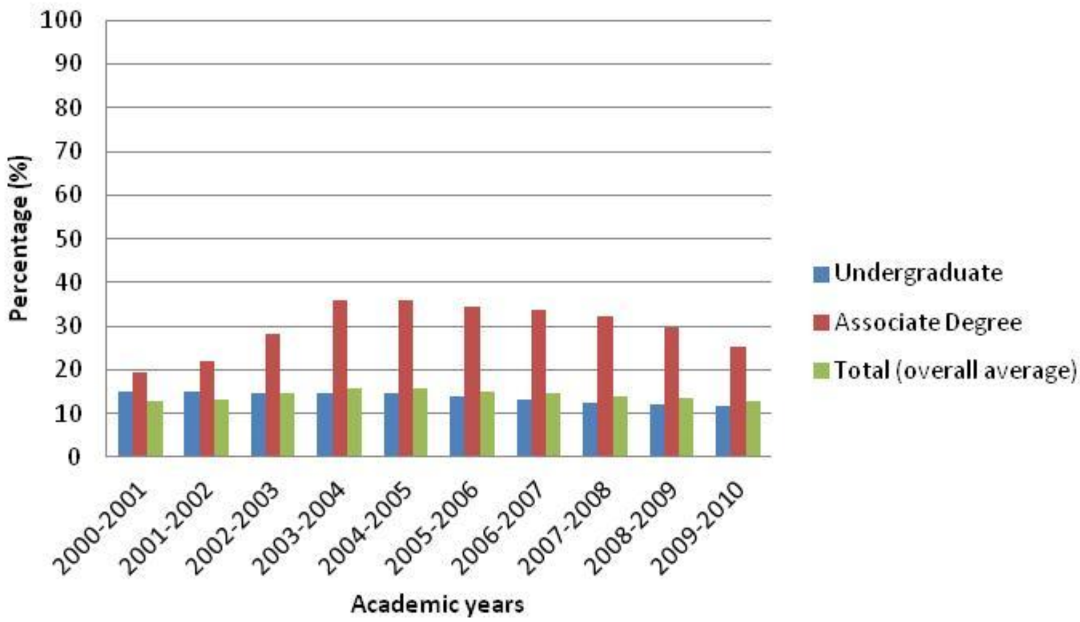


Figure 9.3: The proportion of students enrolled in second education programmes in Turkish HEIs
(Source: OSYM, 2000;2010)

Post-graduate education has now been established in all Turkish universities, although before HECoT these programmes were only available in the major universities. In the period between 2000 and 2010, the proportion of students enrolled in graduate degree programmes (Masters and PhD) has been static at about 5%, although the total numbers have grown (Figure 9.4).

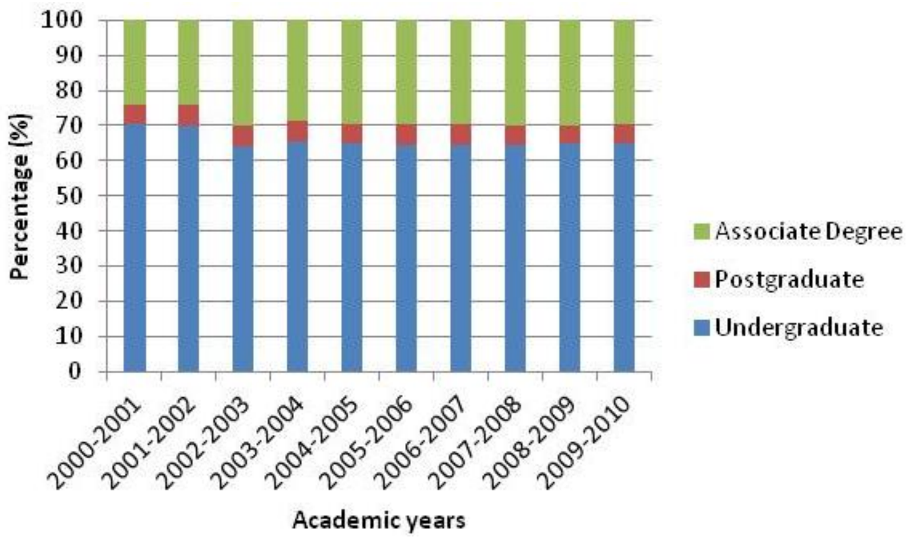


Figure 9.4: The proportion of HE students at different levels in Turkish HEIs
(Source: OSYM, 2000; 2010)

9.2.1 Visions and missions for Turkish Higher Education

In order to understand the context within which Geography and GIS teaching operates in Turkey it is important to appreciate the changing priorities of the Turkish HE sector as a whole. In the last three decades, there have been profound changes. The main drivers have been the work of the Higher Education Council of Turkey (HECoT) and the Bologna process. HECoT have introduced several new initiatives including the shift from the traditional Continental European-based HE system to the Anglo-American model (Guruz 2001).

Law no.2547 (introduced by HECoT in the early 1980) identified three main missions for Turkey's universities, namely education, research and public service. According to this law, seven educational aims were declared for HEIs. Six of them dealing with the personal development of individuals, and with an education based on the country's fundamental political principles, namely secularism, modernism and Ataturk's nationalism, on which the Republic of Turkey has been built. Under HECoT's leadership, the Turkish HE system has been highly centralised, and HECoT has substantial powers in directing the policy for all HEIs (public and private) (Tansel and Bircan 2006). Any significant changes in the universities need to be authorized by the HECoT (Mizikaci 2003) and when compared to the UK, HEIs in Turkey do not have the same level of autonomy. HE's role in underpinning the country's increasingly knowledge-based economy was not made an explicit priority until 2007, a shift which is bringing Turkish HE closer to the UK and many other countries.

Research is one of the main missions of Turkish Universities. TUBITAK[16] (The Scientific and Research Council of Turkey), which has a similar function to the research councils in the UK, is the main agency giving financial support for individual academics' research projects, along with internal University funding. It is important for this thesis on HE teaching to emphasize that there is only one staff reward (promotion) system in Turkey and this relates to published articles in journals with a high impact factor (although there is still no review system like the REF to measure the relative research performance of Turkish Universities and departments).

Despite the emphasis on research in staff promotions, education is the main mission for HE in Turkey, although by UK standards, relatively little attention has been paid to teaching and learning methods or curriculum design. There is no official way (e.g. NSS in the UK) to evaluate students' experiences in Turkish HE, but Kesik (2003) conducted a survey of 5124 students at 52 HEIs in 2001 which revealed that 68.8 percent of students were dissatisfied with the quality of the education they received. It will be

[16] Please visit http://www.tubitak.gov.tr/en/ot/10/;jsessionid=57F97224BA015CA783A7A7A8C0981119

interesting for this Geography-based research to assess levels of satisfaction amongst the GIS students. A strategic report by HECoT (2007) highlighted that the teaching style of HE academics is still largely based on traditional lecturing methods. The main emphasis is on content-driven education, which means that the focus of lecturers is on the factual content of the subject studied (such as Geography or GIS) rather than on how to teach it so that students learn effectively. The HECoT emphasised that lecturers' pedagogical knowledge should be encouraged in order to enable them to make informed decisions as to which teaching method will best meet their students' needs. The argument is that HE teaching should be more student-centred. However, there is still a question as to how these aims are to be achieved. There is little training for HE lecturers and there are no organizations such as the HEA, Subject Centres or CETLs which might help lecturers to develop their pedagogical skills. Moreover, the vast majority of pedagogic research in Universities has been focused on issues dealing with teacher training for the schools sector.

The third main mission of Turkish HEIs has been defined as Public Service by the Strategic Report of HECoT in 2007 which highlighted some key priorities for the Public Service mission, including education for raising awareness (e.g. human rights), underpinning the National Health Service with the universities' hospitals, and lifelong learning. In this report, emphasis was also given to improving educational opportunities for people who are living in the more deprived areas of the country. This is similar to the UK's work on widening participation.

Another important development in Turkish HE was the start of negotiations for full membership of the European Union (EU) in 2006 and Turkey's engagement with the

Bologna process. Although the aim of Bologna is to create a European Higher Education Area (EHEA), for Turkey to align with Bologna some really major changes were needed (quality assurance, degree cycle etc.) (Mizikaci 2003).

The changes required by the EHEA brought a number of issues onto HECoT's agenda such as the qualification frameworks, quality assurance, the European credit transfer and accumulation system (ECTS), student and staff mobility, and lifelong learning (HECoT 2010).

Thus, the integration process of the Turkish HE system into the EHEA commenced with the Bologna Process which provided a stimulus for the reform. Although progress has generally been patchy and uneven, good progress has been made in three priority action lines, namely quality assurance, the three cycle degree system (undergraduate, master and PhD) and international recognition of Turkish HEIs (HECoT 2007). For example, AAQIC (the Academic Assessment and Quality Improvement Commission-ADEK in Turkey) was established through HECoT in 2006. And HECoT's progress report in 2010 said that at least the first step towards a QA system, which is an internal self-evaluation, have been taken in most HEIs.

According to AAQIC's regulation handbook (2005), the QA process principally rests on the internal reviews and reporting process. Universities are expected to submit annual internal evaluation reports to HECoT: the time frequency of the formal external evaluation process is five years. However, it seems that most of these initiatives are focussed more on the quality of management rather than directly on the quality of teaching (Billing and Thomas 2000, Borahan and Ziarati 2000).

One important benefit from the Bologna process has been the preparation of the Qualifications Framework for HE: however, this work is still in progress. The main aim of this framework is to require ILOs for the three main different levels of degree (Bachelor's, Masters and PhD). The HECoT report believes that providing ILOs for degrees will make the QA process easier. It will be interesting to consider the findings of this GIS research with respect to ILOs in Turkey and their implementation (see section 9.5).

So, whilst a well-skilled workforce is becoming important to underpin the rapidly growing Turkish economy, Turkish universities' role in the next decades is still unclear, particularly with respect to employability. Although promoting the quality of teaching and learning has been initiated by creating ILOs for degree programmes and ECTS (the degree qualification framework), the adoption of these initiatives into programmes is still patchy. The structure of the HE sector and staffing issues prevent HEIs from making progress on these issues. Despite the substantial bureaucratic system, Turkey has experienced a poorly planned and unsystematic growth of the HE sector. The following section concerning the development of Geography and GIS education in Turkey explains how these state-level trends affect the nature of Geography and GIS education.

9.3 Development of Geography Degree Programmes in Higher Education

Turkey's first Geography undergraduate programmes began in 1933 at Istanbul University, which was soon followed by Ankara University. The different types of Geography degrees included Physical Geography and Geology, Human Geography and Regional Geography. These courses were pioneered by a first generation of Geography lecturers, many of whom had studied at HE level in the US and European countries (Erinc 1973). These types of different programmes were followed until the birth of the Higher Education Council of Turkey (HECoT) in 1981 who combined them into integrated Geography degree (Seremet and Chalkley 2012).

The guide of the Student Selection and Placement Centre (OSYM) (2010a) notes that there are currently 22 Geography Departments in 171 Turkish Universities. A few of these universities, Istanbul University, Ankara University, Ege University and Erzurum University, have long-standing Geography departments (pre-1992 universities). The other 18 geography departments were established from the 1990s onwards (post-1992 universities). The overwhelming majority of Geography departments (21 out of 22) have been placed in state universities. Fatih University (located in Istanbul) is the only private university that has a Geography department. Additionally, 11 out of 22 departments offer secondary (evening) education for their students (see the section 9.2).

The number of new (first year) admission students for Geography departments range from 45 to 170. However, this number can be changeable according to the decisions of HECoT. There is not a fixed quota for each department. According to OSYM's 2010 statistics, there were a total of 5158 undergraduate and 629 post-graduate geography students registered in geography departments in 2009-2010 (Table 9.2). On the other hand, 168 academic staff were employed in geography department, of which, 132 had the positions which allowed them to deliver a module at degree level. The other staff had titles such as Research Assistant (Post-graduate research students) and Experts and they were not permitted to teach but could do some demonstrating. Therefore, for 2009-10 the average ratio of all academic staff to students was 1:44 (Table 9.2) and the teaching staff-student ratio was 1:34. The rapid growth in undergraduate numbers has caused increases in staff/students ratio. These Geography trends broadly reflect wider HE patterns and in particular HECoT's commitment to expansion (discussed in section 9.2). However, it is important to acknowledge that with less than 6000 students in total, despite recent growth, Geography is a very small part of Turkey's HE system, with much less than one percent of the nation's student population. Nevertheless, Geography at HE is growing and recruiting well and meeting its target numbers while some science subjects are struggling to recruit students (e.g. Physics, Chemistry, Biology) in more recent years.

However, the Geography subject at secondary schools is normally compulsory in Turkey until the age of 16 (unlike the UK where Geography is only compulsory up to the age of 14). The need for teachers has been reinforced by the subject's inclusion in a number of vocational courses (Yasar and Seremet 2009) and more recently, by the change of compulsory education from being eight years to twelve years. This explains the need for the Geography teachers in the country (Seremet and Chalkley 2012).

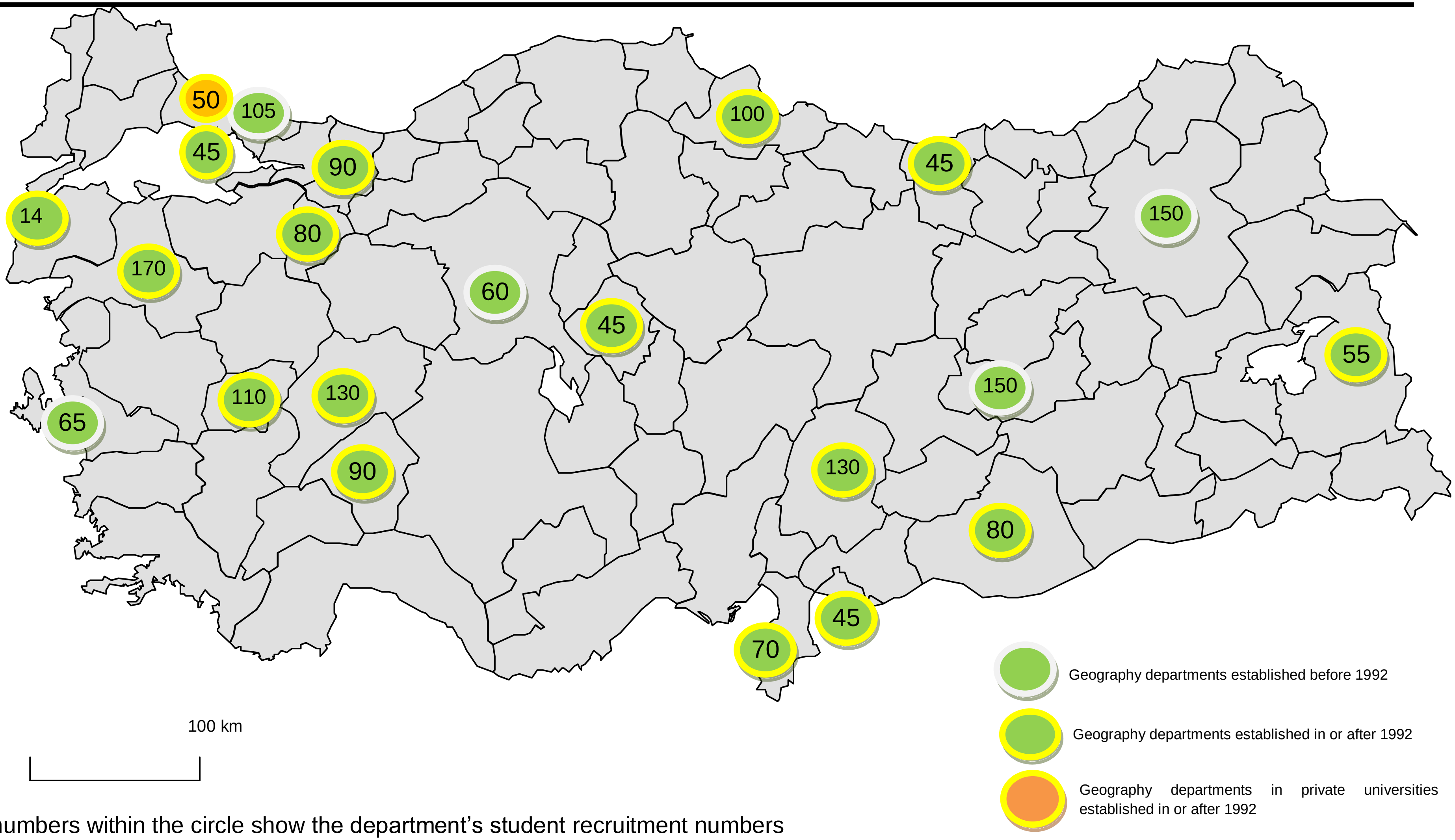
Table 9.2: Total number of Undergraduate, Post-Graduate Students' and Academic Staff in Turkish geography departments during the period of 2000-2010

	Total Student*			Total Academic Staff		Ratio	
Academic Year	**Undergraduate Students**	**MSc**	**PhD**	**Teaching Staff**	**Res. Assist and experts**	**Student/T.Staff**	**Student/All Staff**
2000-2001	2361	191	49	84	48	30,96	19,70
2001-2002	2424	326	104	86	47	33,19	21,46
2002-2003	2408	301	101	90	43	31,22	21,13
2003-2004	2588	285	82	93	37	31,77	22,73
2004-2005	2677	292	84	98	40	31,15	22,12
2005-2006	2917	393	88	99	39	34,32	24,62
2006-2007	3210	285	81	106	44	33,74	23,84
2007-2008	4601	253	94	128	38	38,66	29,81
2008-2009	4216	264	91	126	35	36,28	28,39
2009-2010	5158	504	125	132	36	44.01	34.58

Source: OSYM, 2001; 2010
*****Thıs is a total number of Geography undergradautes excluding the Geography Teacher Training courses' students.

In general, the old universities (pre-1992 universities) represent Turkey's strongest geography departments with respect to research, teaching facilities and the number of academic staff. Drawing upon the number of academic staff employed, the Geography department in Istanbul University is on the top rank with 31 academics[17]. This is both Turkey's oldest Geography department and also the first to teach a module in GIS, followed by Ankara University and Erzurum University. The Geography departments in these universities are all long-standing departments in pre-1992 Universities. The department of Geography in Ege University with 10 academics is Turkey's fourth biggest Geography department. Canakkale Onsekiz Mart University (post-1992) has one of the largest young Geography departments also with 10 academics. With respect to their geographical location, there is some concentration of departments located in the western part of Turkey, with the east slightly under-provided (Figure 9.5).

[17] The information about the staff numbers in the departments was generated by the result of reviewing departmental web-sites.



The numbers within the circle show the department’s student recruitment numbers

Figure 9.5: The distribution of Geography Departments in Turkey

(Adapted from Seremet 2008) (Total numbers of departments and students were accurate at the time of the study being undertaken)

9.4 Introduction to GIS Provision in Turkey

This section provides a general overview of the development of Geography-based GIS provision (see section 9.4.1), after which attention turns to the Turkish Case Study Departments (referred to as TRCSDs) (see section 9.4.2).

9.4.1 GIS provision in Turkish Geography departments

The first Turkish HE teaching in GIS in the late 1990s was typically based not in Geography but in departments focused on Environmental Engineering, Geology Engineering, Planning, Geodesy and Photogrammetry. It is not surprising, therefore, that when one looks at the present GIS landscape, the majority of provision is being delivered by engineering departments (for example, GIS in Masters is 7 programmes in Engineering compared with 2 in Geography). There are over 100 Engineering departments in Turkey, more than four times the Geography figure.

In terms of GIS provision at the undergraduate level, all Geography departments in Turkey have at least one GIS module (Table 9.3). This shows that the idea of a GIS module has been widely integrated into undergraduate Geography courses. The average number of GIS modules per department is '2.8' with the range from '1' to '8'. However, modules in Turkey last for a term[18], meaning that they are shorter and carry less credit than many modules in the UK. Of the 61 GIS modules, 28 (46%) are offered as electives by Geography Departments (with 54% being compulsory). This underlines the fact that there is a much higher proportion of GIS modules which are

[18] In the Turkish Higher Education system, the main education period is divided into two terms (autumn and spring). Each term lasts 14 weeks. However, some institutions are also running a summer term which is generally for students who want to repeat a module which they failed in the autumn or spring term. This depends on the university's regulations, so it is not necessarily true for all institutions, because some HEIs also offer a make-up (retake) exam for those who failed in one of more modules.

compulsory in Turkey (albeit some of these core modules could well be theory-based with no practicals).

Although there are a large number of GIS modules in Geography degrees in Turkey, by contrast there are only two Geography departments with a Masters programme in GIS. One of these is a joint programme that is run by the departments of Geography and Agricultural Engineering. The other one is run simply by the Geography department. There is no undergraduate full GIS programme in Turkey, perhaps because such a course might be seen as too narrow and overly specialized.

Table 9.3: GIS provision in Geography departments in Turkey (2010/11) [19]

Number	Name of University	Name of GIS modules (Undergraduate level)
1`	Fatih University (Istanbul)	Geographic Information Sciences Fundamentals of Geographic Information Systems Advanced GIS (E*) Urban GIS (E*) Business GIS (E) GIS Usability (E) Topics in GIS and Remote Sensing (E) Database Design For GIS (E)
2	Ege University (Izmir)	GIS I (E) GIS II (E) GIS Applications I (E) GIS Applications II (E)
3	Istanbul University	GIS (E) GIS Analysis (E) GIS and Remote Sensing (E) Geographical Information Systems Applications (E) Project design and Management in GIS (E)
4	Marmara University (Istanbul)	Geographical Information Systems (E)
5	Ankara University	GIS I (Fundamental) (E) GIS II (Fundamental) (E) GIS III (E) GIS IV (E) GIS Field Work (E) Topics in GIS (E)
6	Süleyman Demirel University (Isparta)	GIS and Remote Sensing I GIS and Remote Sensing II
7	Giresun University	Geographical Information Systems I Geographical Information Systems II
8	Kahramanmaraş Sütçü Imam University	Geographical Information Systems I Geographical Information Systems II Geographical Information Systems Applications
9	Atatürk University (Erzurum)	There is no curriculum information on the department internet site
10	Yüzüncü Yil University (Van)	Geographical Information Systems I Geographical Information Systems II
11	Çanakkale Onsekiz Mart University	Geographical Information Systems GIS and Remote Sensing
12	Ondokuz Mayis University (Samsun)	Geographical Information Systems (E)
13	Mustafa Kemal University (Hatay)	Geographical Information Systems I Geographical Information Systems II

[19] All information in this table gathered from departmental web-sites, so it is not possible to identify these modules as introductory, mainstream or subject-specific.

Number	Name of University	Name of GIS modules (Undergraduate level)
15	Firat University (Elaziğ)	Geographical Information Systems
16	Balikesir University	Geographical Information Systems I (E) Geographical Information Systems II (E)
17	Harran University (Şanliurfa)	GIS I GIS II Geographical Information Systems Applications I (E) Geographical Information Systems Applications II (E)
18	Afyon Kocatepe University (Afyonkarahisar)	GIS I GIS II Geographical Information Systems Applications in Geography
19	Uşak University	Geographical Information Systems I Geographical Information Systems II
20	Ahi Evran (Kirsehir)	Geographical Information Systems Geographical Information Systems Application GIS Analysis in Human Geography (E) GIS Analysis in Physical Geography (E)
21	Bilecik University	Introduction to Geographical Information Systems
22	Kilis 7 Aralik University	Geographical Information Systems GIS Analysis

9.4.2 GIS provision in the Turkish case study departments (TRCSDs)

Four CSDs were chosen from the twenty-two Turkish Geography Departments (two from pre-1992 Universities and two from post-1992 Universities) to provide a detailed understanding of provision within departments, broadly comparable to that undertaken in the UK. It should be said that the TRCSDs were carefully chosen to be representative (as explained section 4.7.1).

In contrast to GIS provision in the UKCSDs, there is no 'hidden' GIS teaching in any part of the Turkish UG Geography programmes (at least in the TRCSDs) (Table 9.4). This reflects the fact that it is uncommon to have techniques modules in Turkey. However, the first and the second years of the programmes include some compulsory cartography modules which are often called Fundamental Cartography or Computer-based Cartography (e.g. as in TRCSD2 and 3). However, it should be recognized that a Computer-oriented Cartography module may involve teaching some graphic programmes (e.g. Photoshop or CorelDraw) rather than specialised GIS software. These modules are normally compulsory for Geography students in the first and/or second year of their study.

Table 9.4: The nature of GIS provision in the Turkish Case Study Departments (TRCSDs) (2010/11)

Type of Provision	TRCSD1 (pre-1992)	TRCSD2 (pre-1992)	TRCSD3 (post-1992)	TRCSD4 (post-1992)
Introductory GIS module	+	+	-	-
Mainstream GIS module	+	+	+	+
Subject-specific GIS module	+	+	-	-
GIS Masters Programme	-	+	-	-
GIS Undergraduate Programme	-	-	-	-

A number of GIS modules (mainly in pre-1992 institutions) can be classified as “introductory”. These introductory modules include only GIS-theory. This is a category of module which does not exist in the UK. The main difference from the mainstream GIS modules is that their contents are purely based on GIS theory. These modules are taught in TRCSDs1 and 2. Although TRCSD2 offers this type of module as compulsory, the student can leave the degree having had only GIS knowledge rather than skills, TRCSD1 offers its introductory module as an elective, but it was taken by the vast majority of the department’s students.

Mainstream GIS modules are delivered in the 3rd year of the Geography programmes in all the TRCSDs; the reason for this being that the first and the second years include Cartography and/or Introductory GIS modules, which provide an academic platform for the mainstream GIS teaching in year three. Most of the mainstream GIS modules last two-terms in the TRCSDs (although these modules are formally separate, students take them as a pair). The structure of those modules is either “mixed” (theory and practicals go hand in hand) or “practical-driven” (consisting only of practical classes).

Although modules up to and including the 3rd year, vary a little in their content and their structure, the remaining modules at 4th year level are clearly distinctive and different because they have a special Geographical focus and resemble the subject-specific modules in the UKCSDs.

The majority of GIS modules in TRCSDs at Stages 3 and 4 are optional. However, the students do not have an equal opportunity in three out of the four TRCSDs to enrol in these GIS modules since GIS modules require a high level of both computer and foreign language skills (principally English). Moreover, the class size is generally limited to a capacity of 30 students or sometimes less. In order to overcome this problem and decide which students can take the module, the GIS lecturers said that it was necessary to have pre-requisite conditions such as an appropriate level of computer skills, foreign language knowledge, some GIS background (e.g. enrolment in a previous GIS module which is a condition for the 3rd or 4th stages' modules) and a satisfactory grade from the previous year or the previous GIS module (s). However, the recent introduction of an electronic module registration system made these special entry requirements in TRCSD1 impossible; thus, places in mainstream GIS modules in TRCSD1 are now allocated on a "first-come, first-served" basis.

The introductory module in TRCSD2 and the mainstream GIS module in TRCSD4 are, however, compulsory and often taken by more than 40 students (e.g. in 2010/11 taken by 55 students in TRCSD4 and by 70 students in 2011/12). It should be noted that the credit system in Turkish Universities allows students to change their options between the autumn and spring terms, which means that GIS can lose or gain students. The trend in the TRCSDs was for GIS numbers to fall slightly. This is partly because some students find GIS material challenging (e.g. first half of the mainstream module in TRCSD3 involves a lot of digitizing homework which is very time-consuming) and sometimes students are disappointed by the emphasis on theory (for example in TRCSD1).

It must be noted that whereas staff in the UKCSDs normally have the opportunity to run the practical classes more than once, those in the TRCSDs generally do not. In Turkey lecturers have a heavy work-load (see section 9.3) and staff often teach more than three or four different Geography sub-disciplines. So, spending more time on GIS repeat practicals is not possible. So, in Turkey pressures on both staff and accommodation limit students' access to GIS modules.

The structure of Masters degrees in Turkey is different from the UK. Masters programmes last a minimum two years (max. three years). The first year of the GIS programme is made up principally of taught modules and the second year is the project and writing-up stage. In our case-study Masters the taught component compromises four compulsory modules and 10 elective modules. These modules are delivered by six different staff, including two from outside of the department (one is from another department and the other is from the city council).

The Masters taught modules are focussed on GIS and related subjects (such as Remote Sensing, Database Management, Urban Information Systems and GIS applications for Human and Physical Geography subjects). The TRCSD2 Programme Coordinator underlined that these modules are mainly organized so that the first term provides the theory and the second term focuses on the applications.

Development and growth of GIS education in the TRCSDs

GIS education generally started to become part of Geography provision in Turkey in the late 1990s, and this was true of three out of the four TRCSDs. The GIS modules began in UG programmes, and the Masters courses came later.

In Turkey, 4 out of the 5 GISLs interviewed in the TRCSDs had overseas academic experiences which enabled them to develop their GIS skills and so introduce a module on their return to Turkey. This reflects the importance of skills transfer from outside Turkey through to Turkish departments (something which is, of course, happening in my own case).

The GIS curriculum

The UK and Turkish Geography GIS modules have broadly similar GIS curriculum contents. However, there are some differences. These are mainly driven by the fact that software companies in Turkey are much more engaged in GIS training and in supplying their training materials for universities and departments. Therefore, two main GIS vendors (namely, ESRI Turkey and Pitney Bowes Turkey) have been producing software manuals and tutorials that contain exercises and data relevant to GIS teaching. This has been an influential factor affecting the design of module contents, in addition to, of course, the particular research and teaching interests of the GISLs.

The teaching of software tools, spatial analysis techniques (often limited to buffer zone analysis) and cartographic design and production are the main overlapping subjects taught in both the UK GIS modules and those in the TRCSDs. One difference is that the content of GIS modules in the TRCSDs places much more emphasis on data production and data entry. This is mainly because UK Geography departments can obtain this type of data with an online instant access overlay via EDINA-Digimap-, UK Border Agency, and Stats UK etc. However, in Turkey no such facilities are available for educational purposes. Digitization of a parcel of map (1/25.000) might thereby be a course-work assignment and is often an important part of mainstream GIS modules.

The 4th year subject-specific modules typically focus on students producing a project on some aspects (human and/or physical) of a specific field chosen by the lecturer. The content of these modules could therefore change substantially from year to year. They were less heavily documented in terms of module handbooks and this seemed to allow more flexibility.

Departmental infrastructure and support

Three out of the four TRCSDs have dedicated GIS labs. Only one Geography department (TRCSD1) uses a shared lab which is also a computer lab which is open to all departments in the Faculty. In the TRCSDs, the lack of an institutional licence covering all places in the university seems to be one of the main challenges and particularly limits students' project assignments. This is principally because the computer lab is normally busy outside of GIS teaching slots and Universities are not able to offer their students a free licence. Although students can buy a student licence from the company, in many cases this could be expensive (the cost would about 170 Turkish Liras, which is roughly 55 pounds, 45 percent of state universities' annual tuition fees[20]).

Another difficulty can be finding enough computers in the labs (see see Plates 9.1 and 9.2); therefore particularly the GISLs in TRCSDs 3 and 4 ask their students to bring their own lap-tops to the classroom. As one of the GISLs underlined, this difficulty is driven by the fact that Geography is still treated for funding purposes as a subject which can be taught in lecture rooms. Thus, the GISLs said that the availability of a GIS lab is often the result of a sponsorship agreement (e.g. setting up a lab and providing free software) or successful and persistent lobbying activities

[20] The government has recently decided that tuition fees for 'normal time' students will be abolished in 2012/13.

with the University managers (Dean or Rector). Overall, it can be said that insufficient infrastructure is an on-going challenge for Turkish Geography departments, not least because the technology is changing quickly and the infrastructure is one of the main components of GIS teaching and needs to be kept up-dated with respect to both computers and software packages.


Plate 9.1 and 9.2[21]: A view of GIS suite from Turkish CSDs

9.5 GIS Pedagogy: GIS Lecturers

This section focuses largely on GISLs' views and provides an insight into their GIS teaching and assessment approaches and the challenges and problems of GIS teaching mainly at UG and also at MSc level. In order to achieve this, there were interviews with 5 GISLs and a PC (see Table 9.5). In addition, documentation was reviewed (Europe Credit Transfer Systems-ECTS forms, module hand-outs and where available handbooks).

[21] As can be seen from the first plate sometimes there is nice and well-equipped computer lab without having industry-standard software. Also at the next plate, students have industry-standard software but they do not have enough capacity computers, therefore they often bring their own computers into labs.

Table 9.5: GIS staff interviewees in the TRCSDs

Case Study Departments	Provision Features	GIS Lecturers	Programme Coordinators	Total Interviewees
TRCSD1	Geography UG GIS Modules	TRGISL8, TRGISL9		2
TRCSD2	GIS Masters, Geography UG GIS Modules	**TRGISL10***	**TRPC4***	1
TRCSD3	Geography UG GIS Modules	TRGISL11		1
TRCSD4	Geography UG GIS Modules	TRGISL12		1
Total Interviewees		5	1	5

*The use of bold in the row cells indicates that these are same person, but with two roles.

GIS Staff Backgrounds

All the Geography TRCSD GIS modules are delivered by Physical Geographers (mainly specialists in Geomorphology and/or Climatology). The majority of the Turkish GISLs have international experience which was obtained principally to improve their GIS knowledge and expertise. It is interesting that all of the GISLs have a pedagogic certificate dedicated to school teaching which is by far the most common career for Turkish Geographers (see Seremet and Chalkley 2012). Additionally, PhD students in Turkish Universities (except for Education students) have to take two modules (Educational Psychology and Principles and Methods of Education) from the Faculty of Education during the time of their PhD research. Although this provides a foundation in education, these modules are to a large extent focused on approaches to secondary school teaching. Turkish Universities have no equivalent to the teaching courses provided in British HEIs for the new academic staff with little or no HE teaching experience.

The design of GIS modules and the Masters GIS programme

GISLs in the TRCSDs have as much liberty in the design of the module curriculum content as their colleagues have in the UK. At the institutional level in Turkey, issues of academic freedom and bureaucratization are frequently discussed (Balyer 2011).

However, in practice the GISLs have freedom in designing the modules they are teaching. However, this may not necessarily result in effective GIS module design. This is partly because in Turkey there are few opportunities for staff to learn the theory and practice of module design or to share and exchange ideas on GIS teaching and assessment (albeit the GISLs in the UK had made relatively little use of these kinds of opportunities).

There are three sources of ideas which Turkish GISLs used to help design their module contents: a) tutorial notes provided by software companies, b) materials from some overseas universities' (principally in the USA and the UK), c) GIS textbooks (e.g. DeMers 1997, Longley et al. 2005a, Maguire et al. 1991). Overall, the influence of international projects such as NCGIA and BoK seemed very limited. Although there is a mixed approach to module design, there is a consistent view that those who have international experience benefited from the modules or training programmes they attended while they were abroad and adopted or adapted some of their contents. Here it should also be noted that there are two GIS textbooks (Turoglu 2008, Yomralıoğlu 2005) published in Turkish (one of them has been written by a Geographer and the other one by an Engineer). Only one GISL (with post-graduate experience in the UK) showed awareness of the NCGIA materials, and none had any idea about the Body of Knowledge. The coordinator of the Masters programme said that he was mainly influenced by other GIS Masters programmes in the UK and USA, in addition to the web-sites of other Turkish departments.

GISLs' approaches to teaching and learning activities

In Turkey the introductory level theory-driven modules referred to earlier are obviously delivered entirely through lectures. The subsequent parts of GIS provision were also largely lecturer-driven, rather than adopting a more student-centred and active teaching approach. The limited use of practical teaching might be one reason why only two modules in the TRCSDs used module handbooks since detailed practical instructions were not needed. Where there are practical classes they are typically delivered by GISLs through power point with students following the steps by watching the screen. Only in the case of subject-specific modules, typically in the fourth year, is a project-based approach more common, with some active learning.

> We also enrich students' GIS backgrounds by leading them into group-based project work. So, students prepare themselves for working in the private sector at least one or two terms beforehand (TRGISL9, TRCSD1).

During the classroom observations, I observed some dedicated and systematic teaching but there were also problems. For example, when showing a step by step procedure over the screen, not all students keep pace. Moreover, it can be difficult for students to repeat the exercises after the class, where there is no module handbook. Above all, the student role was often passive, with the emphasis being on the lecturer transferring information rather than on student-centred methods.

The review of module information documents for Masters modules showed that there is typically little or no difference in teaching methods and in-class activities at Masters level. Nevertheless, two modules (Urban Information Systems and Remote Sensing modules) included fieldwork, although the precise nature and role of the fieldwork was unclear and not documented.

Assessments

Both introductory and mainstream GIS modules have formal examinations which are weighted at anywhere between 20 and 100 percent of the module marks. The introductory type GIS modules are often assessed only by invigilated exams (100%

weighted). However, the figure in mainstream modules is much less and these modules are normally assessed also by various forms of coursework such as a project reports.

With respect to Masters levels, the dominant model was an in-class mid-term test (40%) and a final exam (60%). Even if there are some gaps between the assessment statements in the ECTS forms and what is actually done in practice, it is very clear that at Master level in Turkey assessment methods tend to be traditional.

Whereas ILOs were, in principle at least, important features of the GIS modules in the UK CSDs, in Turkey, although there are a few ILOs in the ECTS forms, they are a much less prominent feature. My impression was that the filling of ECTS forms was rather quick and that even where ILOs exist, they are even more of a paper exercise than they are in the UK. The Bologna process gives considerable priority to ILOs and their key role in curriculum design and assessment. However, in the TRCSDs they had clearly not yet achieved this status.

Wider Use of GIS

The Turkish GISLs emphasized that the main place where GIS was used outside GIS modules is students' dissertation projects which are a common feature of Geography provision (although TRCSD1 has no dissertation module). No data was available on the number of students using GIS in their projects but they were clearly only a small minority.

Another part of the curriculum where GIS experience could be expected to appear is in work-placement modules. However, only one TRCSD had a work-based learning module, although it was in this case a compulsory part of the Geography programme. About 10-15 percent of students in this module, were placed in organizations making considerable use of GIS (mainly central and local government). In spite of having no formal work placement, the GISLs in the other TRCSDs said they often helped their GIS students to find a position for a summer placement but this was not formally part of the curriculum. There was also little evidence of GIS playing an important part in fieldwork. So the general picture was one of GIS not penetrating much beyond the designated module-a similar picture to the UK.

Challenges and problems

All the Turkish GISLs agreed on two main challenges and problems: a) students' academic backgrounds and b) the departments' technical infrastructure. The staff felt that most students taking GIS modules lack sufficient quantitative and technical expertise. This is mainly because Geography students' university entrance marks mainly come from the social science part of the University Entrance Exam. Although several attempts have been made by Geography departments to change their entrance requirement to a Social-Maths balanced mark, they have not succeeded in persuading the government to make this change. This government control over Geography entrance qualifications illustrates the centralized character of Turkish Higher Education. Surprisingly, one of the TRCSDs had, nonetheless, managed to alter their UG programme from being social sciences weighted to science weighted: however, the students do not seem to be very happy with this situation, because it involves them doing Maths, Chemistry or Physics modules in their first year.

One of the GISLs highlighted that students concentrating on rote-learning in school education are often still in the same mode in HE, which might be one reason why it is difficult to make students more autonomous learners. Although Geography in schools both at primary and secondary level has recently undergone substantial changes in teaching approach and content (Yasar and Seremet 2009), it seems that at present HE staff are still rather doubtful about the ability of students to engage effectively with a curriculum with more opportunities for project and group work.

As indicated earlier, the staff felt that the other main problem facing GIS education in Turkey is insufficient infrastructure. Although most departments have a lab (sometimes shared), their main problem seems to be updating and providing enough spaces and computers for students. For instance, in the case of TRCSD4, the Geography department has a lab with 40 brand-new computers and MapInfo software (the most convenient and affordable software). However, their student numbers are increasing (2011/12 their intake is intake 70) and they do not have the budget to provide their students with ArcGIS software. In the case of TRCSD1, they have a software licence for 35 computers, but their labs are mostly shared which is inconvenient for GIS teaching activities. In the words of one GISL:

> If we had our own proper GIS lab, it would make a big difference to GIS teaching both for me and for my students: we could take more students and improve their GIS skills. (GISL9, TRCSD1).

Moving on to consider the GIS Masters programme, the main issue underlined by PC4 is again directly related to students' backgrounds and in this case their lack of a sufficient GIS basis on entry. Also, the Master enrolment process is still very challenging in that in addition to individual interviews, all students must have some marks from a national foreign language exam (normally English) and have passed the Graduate Record Examination (ALES in Turkish); fairly similar to one in the USA which includes both verbal and numeracy questions. This challenging process discourages many professionals in the job market from doing a Masters in GIS. Therefore, the main recruitment group for these kinds of Masters tends to focus on recent graduates and those who plan to pursue an academic career.

9.6 GIS Pedagogy: Students' Perspectives

This section focuses on the experience of students taking Geography GIS modules (they were also eight Masters students). As can be seen in Table 9.6, 137 undergraduate students from the four TRCSDs were surveyed. Two key sample features immediately stand out: one is that almost all of them are in the 18-25 yrs bracket which reflects Turkish Higher Education as a whole (97% of UG students are under the age of 25) (OSYM 2011). This is also partly related to the country's young population profile (almost half of the population are under 30) (TUIK 2011). The second sample attribute is that about 70 percent of respondents were third year students, which is the level of most of the mainstream GIS modules. It should also be said that 13 students in the TRCSD3 were from the 'evening education'. Regarding gender, the figures of the participants (47% female and 53% male) reflect the general balance across HE (49% female and 51% male). Eight Masters students were also surveyed. Although this number is small, it should be borne in mind that eight is the total number of students on the case-study Masters programme (Table 9.6). It should be said that all post-graduate courses in Turkey are full-time.

Table 9.6: The main characteristics of survey participants in Turkey: Geography UG and MSc students

Students' demographic features				
Demographic attributes	**Number**		**Percentage (%)**	
	UG	**MSc**	**UG**	**MSc**
Gender				
Female (F)	64	6	47	75
Male (M)	72	2	53	25
Total	**136**	**8**	**100**	**100**
Age Group				
18-25	136	4	99	50
26-33	1	4	1	50
34+	0	0		0
Total	**137**	**8**	**100**	**100**
Level				
2	27	-	20	-
3	98	-	71	-
4	12	-	9	-
Total	**137**	**-**	**100**	**-**
Total	**137**	**8**	**100**	**100**

Degree Choice

As in the UK, a question dealing with whether GIS affected their decision to choose an undergraduate programme in Geography was directed to participants and over 80 percent of those questioned answered 'No' (85% in UK). This suggests that there is relatively limited awareness of GIS before coming to University, despite the fact that in 2005 the government recommended GIS for inclusion in the school Geography curriculum (Incekara 2010, Yasar and Seremet 2009). However, Geography teachers' attitudes in Turkey towards using GIS (Demirci 2008, Demirci 2009, Incekara 2011) are at best patchy, because of insufficient infrastructure. Nonetheless, for a small number of students the availability of GIS was a factor in choosing HE Geography.

> I chose Geography because I am interested in maps, so GIS is an important module for me (GUG303, TRCSD1).

Regarding the reason for choosing a GIS module, the Turkish students mainly opted for GIS either because it was interesting or because they considered it a useful skill.

> I thought that information technologies have become important in professional and daily life, so GIS would be useful to learn (GUG246, TRCSD2).
>
> It seems to me interesting and somewhat different from other geography modules (GUG250, TRCSD3).

However, career benefits, which was the most commonly cited reason in the UK (34% in UK), was only the second most common reason in Turkey. Although a mainstream GIS module is compulsory in all the TRCSDs, this result suggests perhaps that students may not have received enough guidance about the career opportunities in GIS. This might derive from the "stereotypical" perception of Geography in Turkey as a school subject. The potential for GIS to raise job opportunities for Geography graduates outside of teaching is encouraging, but not yet sufficiently widely understood.

> Actually, GIS is one of the modules, which has helped to abolish the perception that Geography graduates can only work as teachers. Having received a GIS education, I recognize that I can work in many places (city council, urban planning, environmental agency etc.) (GUG312, TRCSD1).

Teaching and learning, activities

This section investigates the students' experience and their opinions about GIS teaching and learning activities (not lectures) in the TRCSDs. As can be seen in Figure 9.6 (for UG students), the most commonly used teaching and learning activities were activities 2 and 3 which are also the same activities named by most of the UK participants, namely projects and structured exercises. However, there are two main differences. The first is that the frequency of these activities is lower than in the UK: this could be related to the fact that in Turkey some GIS modules focused solely on theory. The second difference is again the lower frequency for using Activity 11, namely secondary data collection online or in the field. This is mainly, because there is no agency in Turkey specialising in providing data sets or digital maps which can create the information infrastructure for GIS teaching. Another notable feature highlighted by Figure 9.6 is low scores for work placement activities.

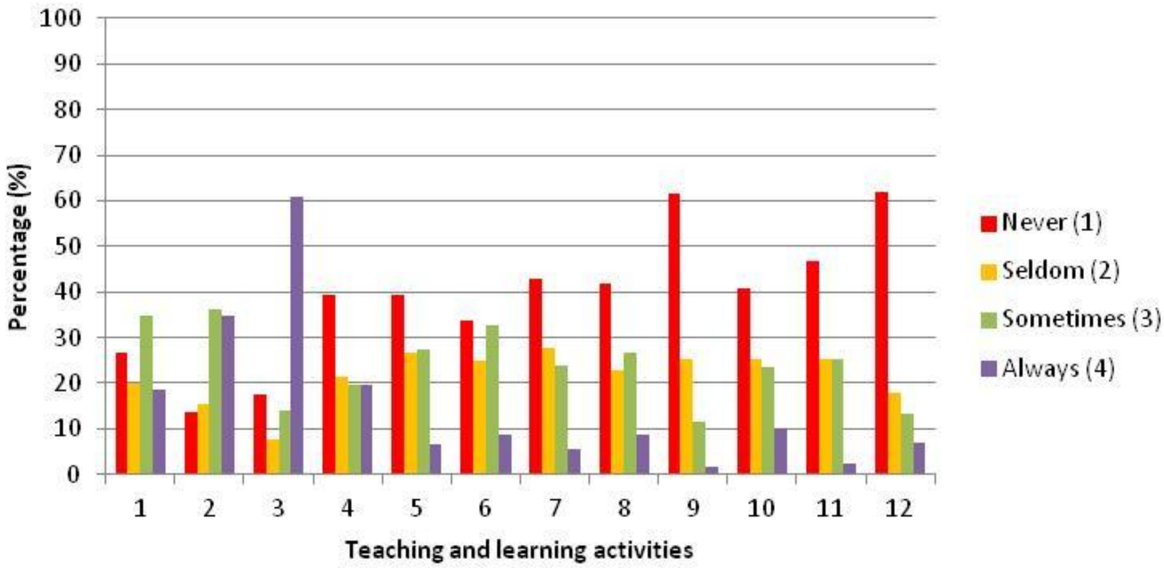


Figure 9.6: Frequency distribution (%) of undergraduate respondents' answers on the amount of use made of various teaching and learning activities (Turkey) *(**Key:** 1. GIS project planning tasks; 2. Undertaking a GIS project (s).; 3. Structured GIS activities in a computing suite.; 4. Mobile GIS using activities by handling Notebook or PDA.; 5. Data collection activities by using compass or other analogue survey methods in the field.; 6. Data collection activities using GPS in the field.;7. GIS using activities in the field. ; 8. Orienteering activities in the field using GPS, GIS or maps.;9. Primary data collection activities e.g. interviews or questionnaires; 10. Presenting results of GIS activities (either oral or poster presentations); 11. Secondary data collection activities in the field or online.; 12. Work-placement learning activities in a real working environment*

These descriptive results were taken further by an ordinal regression analysis to search for patterns and relationships in the data. As in the UK, activity 2 (the amount of GIS project work) was found to be particularly interesting. Although there was no relationship with gender or university name (CSD) it was found that 2nd year students were less likely to experience this form of teaching than 4th year students. This suggest that 4th year students were nearly 2.5 times more likely to experience this activity compared to students in the 2nd year. It seems that in Turkey, with its generally stronger emphasis on theory and lectures, project work was most likely to be reserved for the final stage of the course.

As in the UK, Turkish Geography UG students found the practical parts of the GIS modules to be the most valuable (Figure 9.7), with the least valuable feature being too much emphasis on theory (Figure 9.8). The lack of enough practicals is mainly related to the issues of infrastructure (the lack of a licence for off-campus use, the lack of dedicated computer labs and the pressure on staff time ruling out repeat classes). The curriculum bias towards theory relates especially strongly to Turkey's introductory GIS modules which are completely devoid of practical exercises. Here students have no chance to concurrently practise what they have learnt from the theory. Nevertheless, as in the UK, the Turkish GISLs strongly believe that a solid grounding in theory is necessary for successful GIS teaching and learning.

Figure 9.7: Tag cloud of UG students' opinions on the most valuable part of GIS teaching (Turkey)

Figure 9.8: Tag cloud of UG students' opinions on the least valuable part of GIS teaching (Turkey)

The data in Figure 9.9 suggest that Masters students were more involved in primary data collection processes when compared to Masters participants in the UK. This could be the result of the fieldwork or smaller class size in Turkey. However, there is some doubt as to the reliability of this finding on primary data collection because it does not triangulate with either the module handbooks or comments made by staff. Moreover, it is important to remember that the Masters data relate to only eight students.

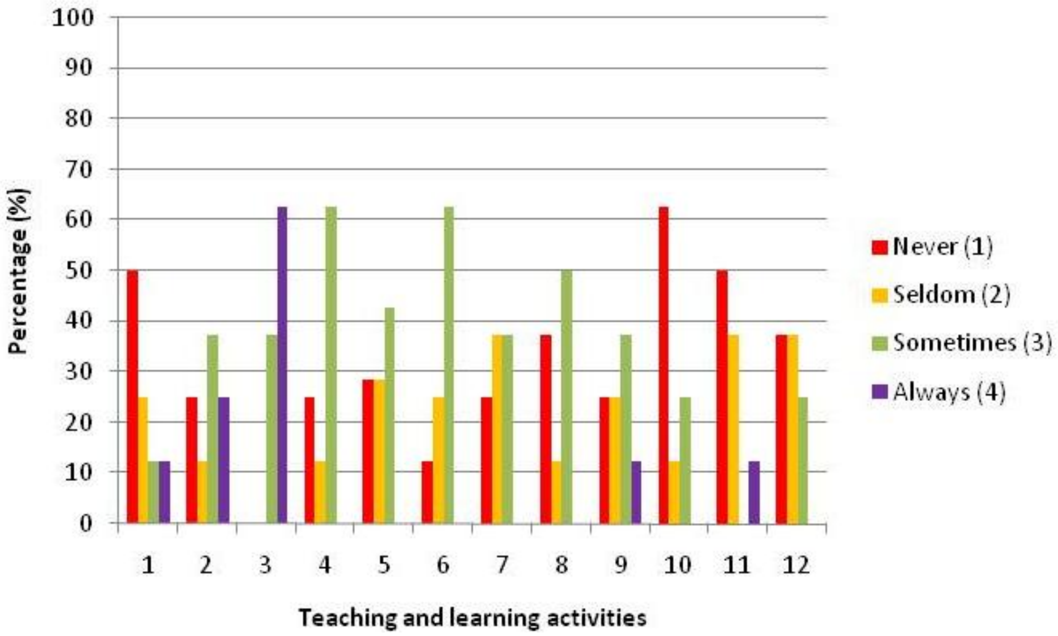


Figure 9.9: Frequency distribution (%) of Masters respondents' answers on the amount of use made of various teaching and learning activities (Turkey) ***(Key:*** *1. GIS project planning tasks; 2. Undertaking a GIS project (s).; 3. Structured GIS activities in a computing suite; 4. Mobile GIS using activities by handling Notebook or PDA.; 5. Data collection activities by using compass or other analogue survey methods in the field.; 6. Data collection activities using GPS in the field.;7. GIS using activities in the field.; 8. Orienteering activities in the field using GPS, GIS or maps.;9. Primary data collection activities e.g. interviews or questionnaires; 10. Presenting results of GIS activities (either oral or poster presentations); 11. Secondary data collection activities in the field or online; 12. Work-placement learning activities in a real working environment)*

Assessment

All students' opinions were obtained on the extent to which assessment techniques helped them to improve their GIS skills and knowledge. For UG students, the overall result showed that just over 50 percent thought that assessment approaches helped their understanding of GIS (Figure 9.10). The general impression from the overall scores is slightly different from the UK (nearly 70% in the UK). The "little or no help" categories are almost invisible in the surveys of UK students (less than 5 percent), whereas in Turkey, the figure is about 15 percent. This may be related to the types of assessment methods used in Turkey which tend (even more than in the UK) to be traditional and to emphasise assessment as a measurement tool rather than a means of promoting learning.

In addition to these descriptive features of the data, an ordinal regression model containing gender, university name (CSD) and year of study was tested to see whether these factors have an effect on students' answers as to how far assessment activities helped their learning. Gender had no impact, but it was found that final year students were significantly more likely (5 times) to report positively on the value of assessment for learning, a pattern which derives from the less frequent use of formal unseen exams towards the end of the programmes. It was also found that students in TRCSD3 were significantly more likely to report that assessment helped their learning than those in TRCSD4 (3.5 times). The reason for this probably also relates to the fact that in TRCSD3 relatively little used was made up of formal exams.

Additionally, the association was examined between assessment and other variables, namely how far students' expectations had been met and how satisfied they were overall. A Spearman's rank correlation test showed a medium level linear correlation with both expectation and satisfaction ($r=0.53$, $r=0.46$ respectively, both significant at p 0.01). Once again, the results point to a link between assessment and the perceived quality of their GIS teaching.

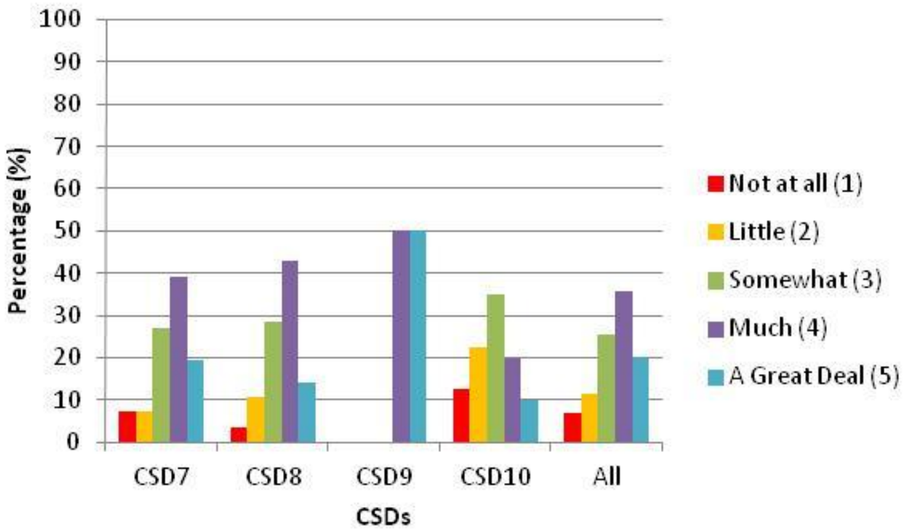


Figure 9.10: UG students' opinions on the value of the assessment process for their GIS learning (Turkey)

Students' views about assessment can be illustrated by the quotes below:

> Instead of exams, assessment should be based on assignments and projects (GUG213, TRCSD4).
>
> It is completely wrong to assess by exams in a module that should have included practicals. I need GIS experience in daily life, fieldwork or doing a project. Memorizing or getting a high mark in the exam is not enough (GUG292, TRCSD1).

Neither staff nor student responses nor my teaching observations revealed any significant awareness of ILOs and the constructive alignment approach (Biggs 1996) of linking assessment to ILOs. This approach is really not yet in evidence in the TRCSDs, and similarly from my discussion with the TRGISLs and my teaching observations, it seems that the concept of "assessment for learning" is not really widely discussed or practised.

The MSc students had basically similar views to the undergraduates. Although five of the eight said the assessment process had most definitely helped their learning (see Figure 9.11) – often through encouraging revision study – they too felt that the assessment process was rather traditional with an over – reliance on testing memory.

> Homework and exams help me to make more practice on GIS software (MSc34, TRCSD2).

Wider Use of GIS in Geography Degree Programmes

As in the UK, the Turkish Geography students confirmed the generally low level of use of GIS outside the specialist modules. As can be seen in Figure 9.12, the overall responses for the 'Never' or 'Rarely' categories came to over 60 percent (75% in the UK). This result was closely followed by the 'sometimes' category where students have occasionally used GIS either for creating a map (usually thematic and density types) in other modules (mainly physical geography) or for their dissertation projects. It should nevertheless be emphasised that teaching with or about GIS is far from widespread in other Geography modules. The ordinal regression analysis was run to see whether the amount of wider use of GIS varied with the year of study, but in this case there was no significant relationship.

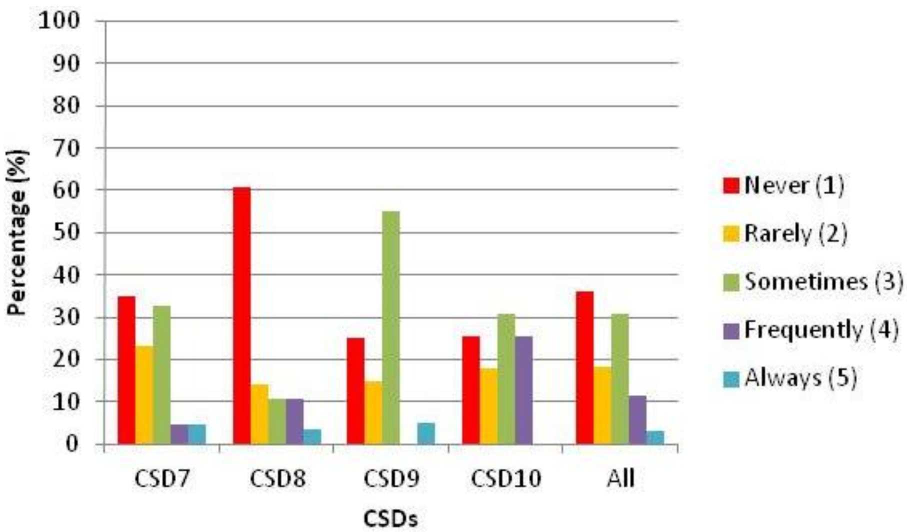


Figure 9.11: UG students' views on the wider use of GIS in their Geography programme (Turkey)

Another issue to be considered here is the differences between GIS and other Geography modules. Being sometimes computer-based and featuring practicals are the main distinctive features given by the Geography-GIS students (Figure 9.13). In the same way that GIS was rarely featured outside the GIS modules, the same is true of practical-based teaching generally. It seems that whereas GIS can sometimes involve a practical component (though not as much as students would like), laboratory or practical-based teaching is very rare elsewhere. Perhaps in part because of the high student: staff ratios, most Geography teaching in Turkey is lecture or seminar-based.

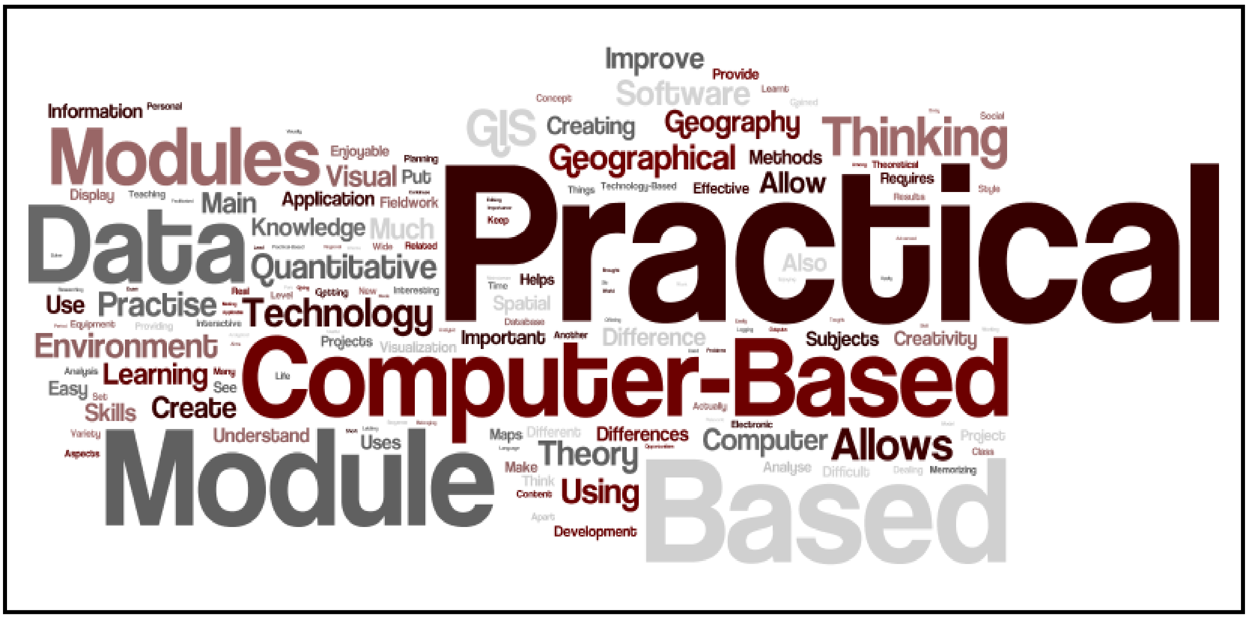


Figure 9.12: Tag cloud of UG students' answers given to the question on what differentiates GIS from the other Geography modules (Turkey)

Expectations and satisfaction

As seen in Figure 9.14, UG students' opinions were quite varied on how far their expectations had been met but 46% were in the "to a great or very great extent" categories.

These descriptive results were further investigated by ordinal regression analysis. The test was run in order to see how far gender, year of study and university name (CSD) might explain the variations in students' expectation levels being met. It was seen that year of study and university name are associated with students' expectation levels being satisfied. The 4th year students are nearly 2.5 times more likely to feel that their expectations were reached. It seems that students in TRCSD3 were also especially positive in this regard - this might well be the result of the more extensive use of project and CW-based assessments in this department.

Additionally, as in the UK, there is a substantial significant linear correlation between expectation and satisfaction ($r=0.68$, $p<0.01$). As one might anticipate, this again suggests that when students' expectations are met, they tend to be more satisfied.

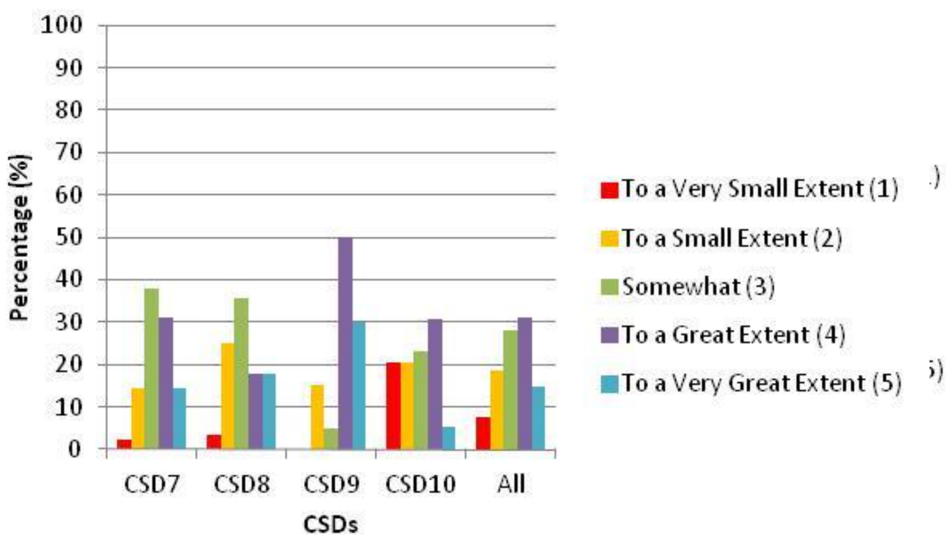


Figure 9.13: UG students' answers as to how far their expectations of their GIS module were met (Turkey)

This is rather lower than in the UK where the corresponding figure was 54%. As indicated previously, the main disappointments related to infrastructure problems and above all to the balance between theory and practicals, as illustrated below:

> It would be much more helpful if we had been exposed to some practicals dealing with real problems (GUG275, TRCSD1).
>
> I thought there would be more practicals and projects within this module; in practice it was the exact opposite (GUG185, TRCSD4).

Furthermore, some students raised software issues. One group in CSD10 using MapInfo software (which is available for off-campus usage) complained about not using industry-standard software (e.g. ArcGIS), whereas the group of students who are using ArcGIS software were disappointed by the lack of opportunity to use it at home, as illustrated below:

> We don't have any opportunity to use software outside of the classes, because buying a licence for GIS software is too expensive for us (GUG222, TRCSD2).

These views support the findings of Madsen and Rump (2012, p.107) that some students like to learn GIS by employing a strategy of "playing with the GIS software" and practising with it extensively at home.

In relation to students' satisfaction, the overall results showed that GIS teaching is considered satisfactory or better by 70 percent of the students (77% in the UK) (Figure 9.15). This suggests that despite some challenges (e.g. software and insufficient practicals), most Turkish students are basically happy with the GIS education they receive. Moreover, the GIS students had much higher satisfaction levels than those reported by Kesik (2003) for Turkish students generally. As with the UK participants, this satisfaction is mainly because they see GIS as a potentially useful set of skills and one which, prior to University, they had not experienced.

Additionally through ordinal regression test it was found that the students in TRCSD1 and TRCSD3 are more likely to be satisfied than those who are studying GIS in TRCSD4 (2.6 and 1.6 times more, respectively). In addition, 2nd year students seem to be the least satisfied group in the TRCSDs – this again might well derive from the more formal lecture-based teaching which tends to dominate year 2.

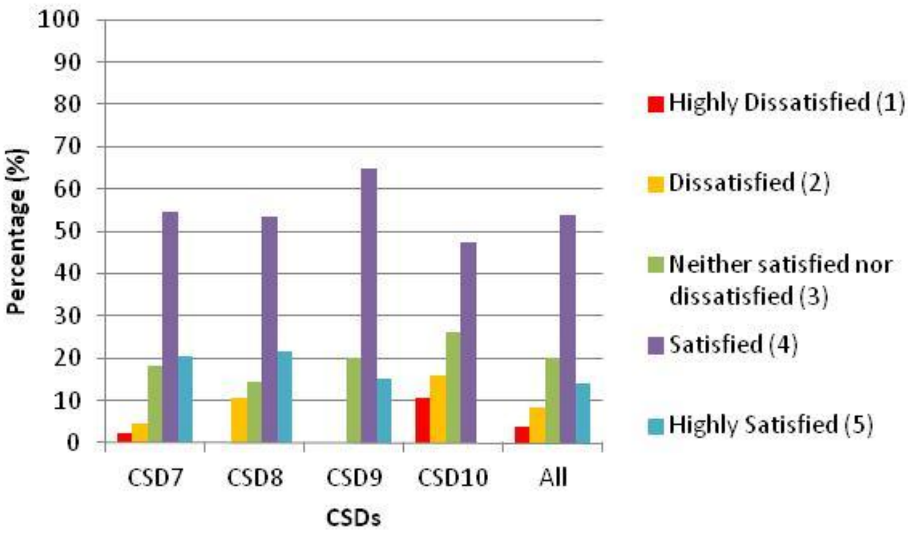


Figure 9.14: UG Students' level of satisfaction with their Geography GIS modules (Turkey)

The following quotes illustrate the overall level of satisfaction:

> I think that I have enough skills to use GIS in the future (GUG301, TRCSD1).
>
> The best things were learning a piece of new software and gaining a set of skills that will be useful in the future (GUG222, TRCSD2).

In relation to MSc students' views, six of the eight said that their expectations were met either somewhat or to a great or very great extent and the same six said they were satisfied or very satisfied with the programme. The students' main criticism related to not enough contact hours (typically eight hours per week) and a to lack of active learning (e.g. insufficient fieldwork and placements). Although this Masters programme has more time and space in the curriculum than those in the UK, these views suggest that it could be more intensive and offer a wider range of active learning opportunities.

9.7 GIS and Employability

Having discussed GIS teaching from the perspective of students and lecturers, this section focuses on employability issues and, in doing so, covers both views from academia and from GIS employers. The focus is on how far the graduates have the GIS skills needed for employability.

9.7.1 Perspectives from academia

Students' perspectives

The Turkish UG students typically felt that their GIS skills were developed at a modest level (as can be seen in Figure 9.18) but a few skills (for example, 10, 12, 13 and 14) were developed to moderate and advanced levels: these are mainly dealing with the creation of data rather than with spatial analysis. As mentioned earlier (see section 9.4.2), the curriculum in mainstream GIS modules in the Turkish CSDs gives more attention to creating data. If the departments do not offer any subject-specific modules, they typically avoid drawing on spatial analysis exercises often found within individual projects. The skill of dealing with loading data from national data sets (no. 3) is one that the majority of students ranked at either “no experience” or only “know the basics” level. Again this underlines an important infrastructural difference between UK and Turkish Geospatial information. With respect to advanced level GIS skills, it is no surprise that the majority ranked them in the category of “no experience”; the modules do not cover this material. A similar pattern was found in the UK (see section 8.2.1).

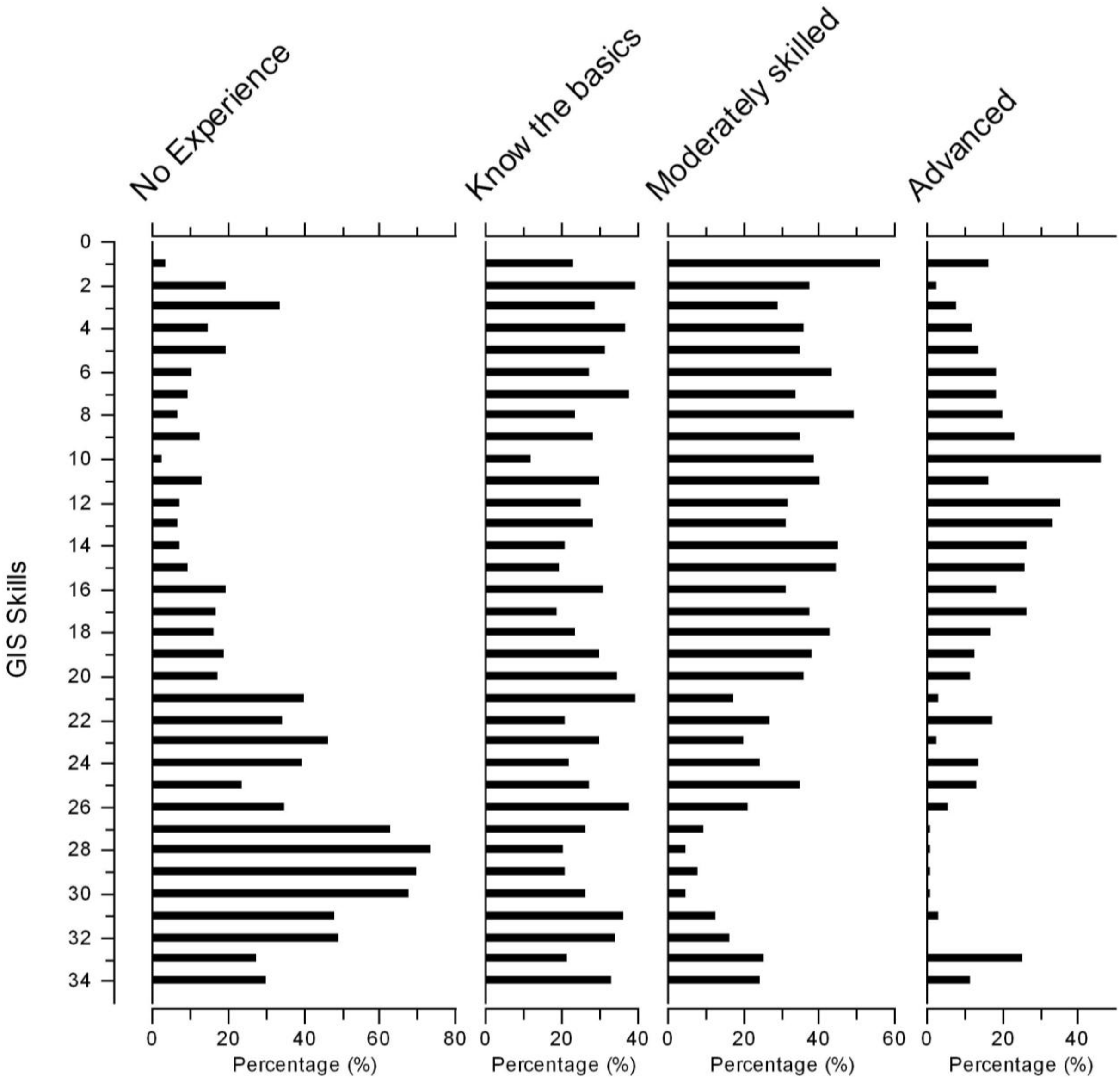


Figure 9.15: The views of Turkish UG Geography GIS students on their GIS skills levels (n=108) (The key for this graph is provided on Table 8.1 in section 8.2.1)

Note: when generating this graph, 27 UG students in the TRCSD1 were eliminated from the analysis, because they were enrolled only on an introductory theoretical-driven module which does not include any practical GIS skills and it was too early for them to make reflective judgements.

Figure 9.19 presents the GIS skills results for the eight MSc students. Figure 9.20 compares the views of the UG and MSc students and shows that generally the Masters students report higher competency levels but not substantially so. That the differences are not larger may reflect the fact that most of the students enrolling on the MSc programme had little or no GIS backgrounds on entry. It may be, however, as suggested above, that students (Masters and undergraduate) judge their expertise not in absolute terms but relative to their expectations or even perhaps to the performance of their peers.

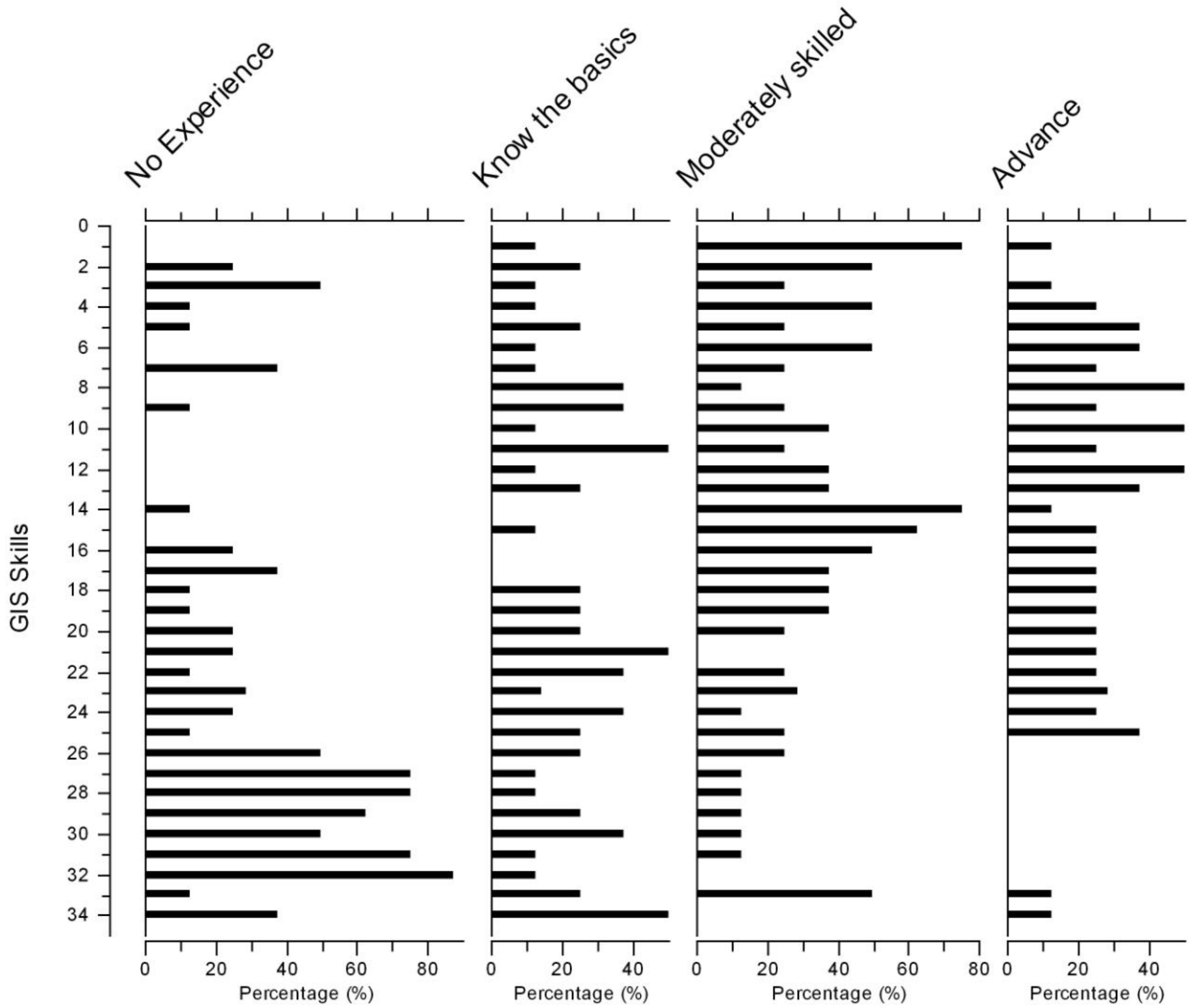


Figure 9.16: The views of Turkish GIS Masters students on their GIS skills levels (n=8)
(The key for this graph is provided on Table 8.1 in section 8.2.1)

Figure 9.17: The comparison between the views of Turkish Geography UG and MSc students

Note 1: A score of 1.00 means that students say they have no experience in this GIS skills area. The top value of 4.00 means that students rate their competence at 'advanced'.

Note 2: The above information is presented in graphical form, because there is a gradient, moving from left to right, from the relatively "easy" skills (with low numbers) towards the more "difficult/complex" skills (with high numbers).

With respect to the development of UG and Masters students' transferable skills, Figures 9.21 and 9.22 show that the majority of students felt that their transferable skills were to some extent (normally "minor") enhanced by the GIS teaching, although most GIS MSc students agreed that there had been no effect in the area of leadership. Indeed, overall the Masters GIS teaching did not appear (despite its extra length) to have more impact than the UG GIS modules. As discussed later in section 9.6.2, the skills and employability agenda in Turkish HE is still at a relatively early stage of development, which may perhaps explain why both the Masters and UG students do not report a more substantial effect on their transferable skills.

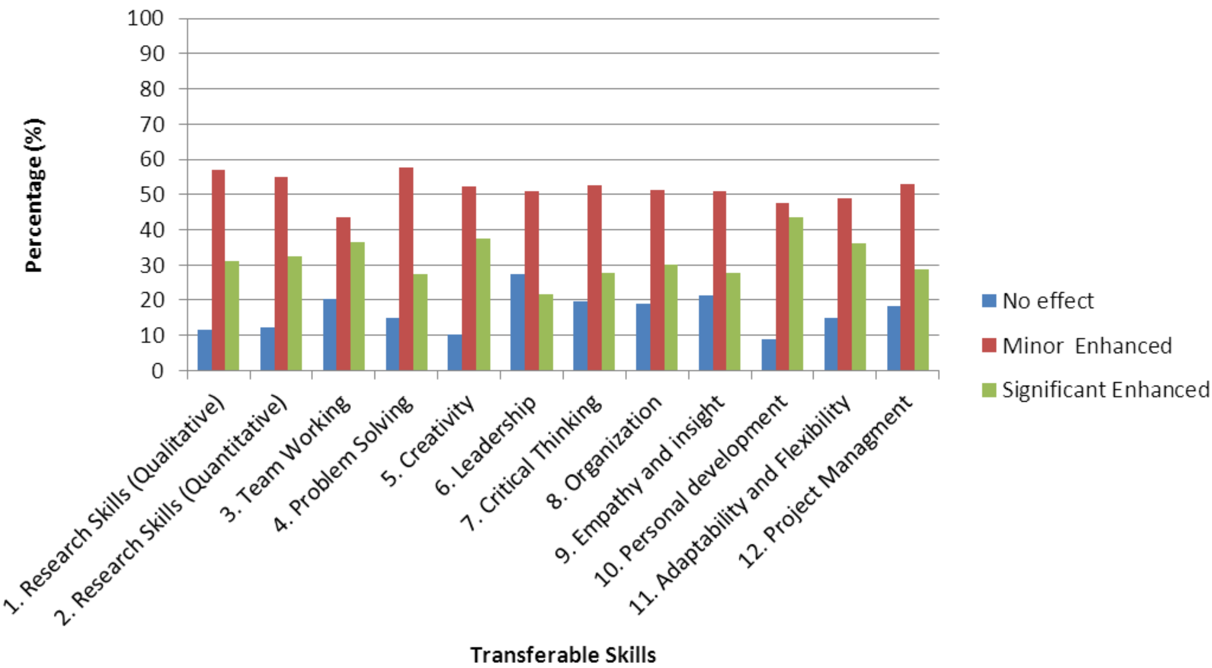


Figure 9.18: The transferable skills impact of the GIS module(s) as rated by Turkish UG Geography students

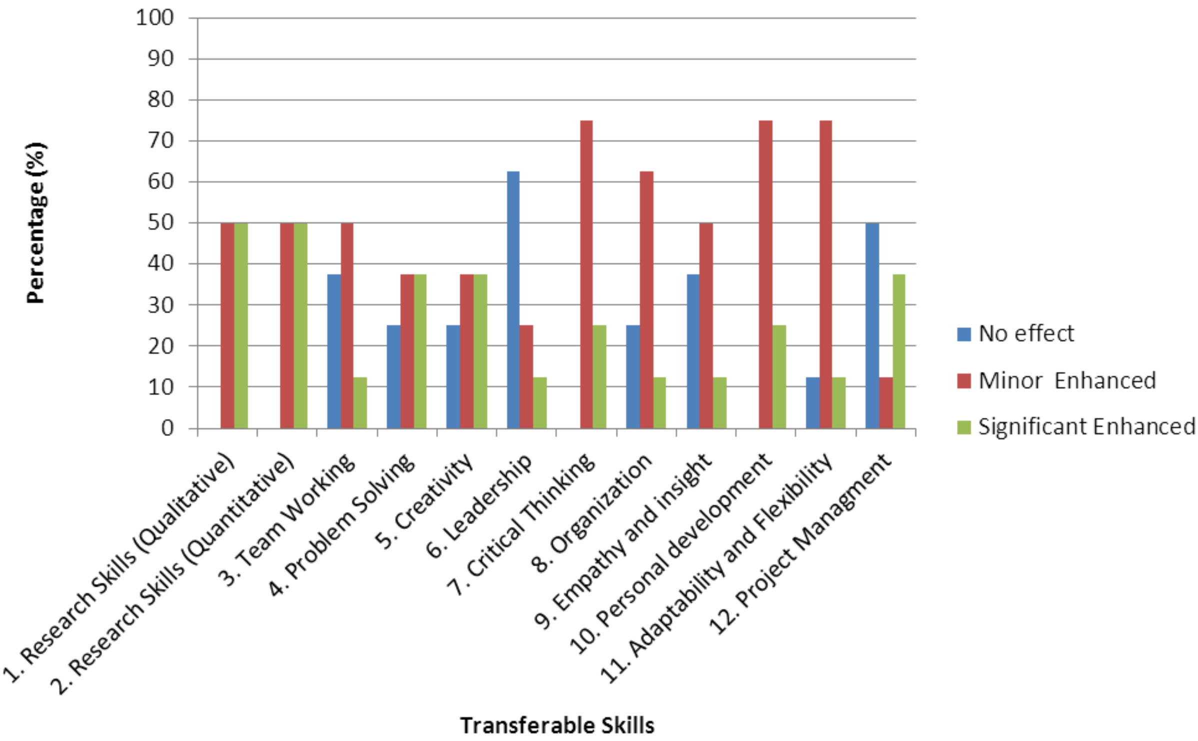


Figure 9.19: The transferable skills impact of the GIS module(s) as rated by Turkish MSc GIS students

The discussion now turns to consider the Turkish students' career aspirations. Relative to their UK UG counterparts, the Turkish Geography students seem to be more enthusiastic about careers in GIS. Figure 9.23 shows that in the TRCSDs the majority of the survey students said they would like a GIS career: the overall figure was 66% compared with only 30% in the UK. Although "career" was only the second most important reason given by Turkish students for choosing a GIS module (see section 9.4), many nonetheless like the idea of a GIS job. Moreover, It should be borne in mind that the "no" answers will have been inflated because some students were taking mandatory (not optional) GIS (TRCSD4). Among the many saying "yes", there will have been students who perceived GIS as one of the few career opportunities outside school teaching.

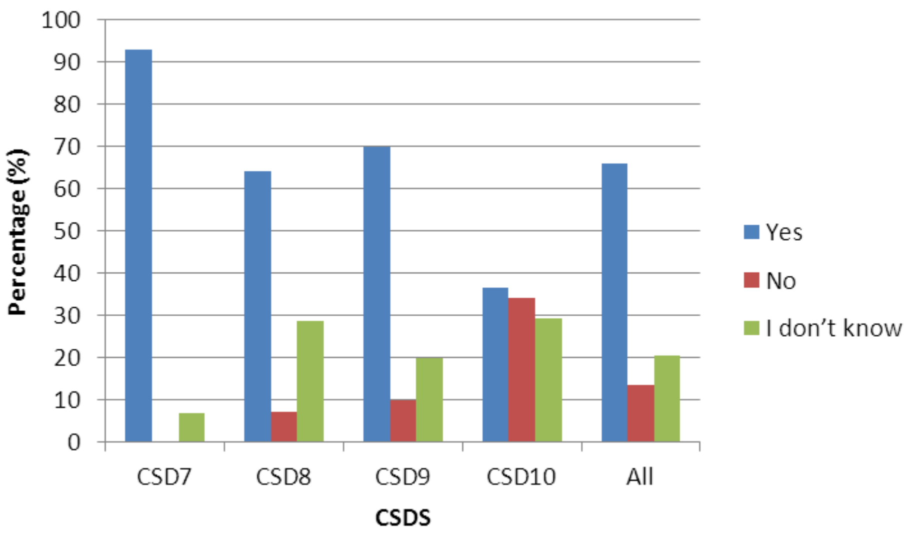


Figure 9.20: UG Geography GIS students' views on whether they would like a career in GIS (Turkey)

The quotes below illustrate the kind of reasons given for wanting a GIS job:

> It is interesting and like to use GIS, so I want to work in a job dealing with GIS (GUG213, TRCSD4).
>
> Becoming a teacher is getting difficult, so GIS is an alternative job opportunity for me (GUG294, TRCSD1).

Some also want jobs which are not with specialist GIS companies but where they can nonetheless use their GIS skills:

> I want to get a job requiring using GIS rather than being a GIS expert. I would like to make use of GIS applications (analysing, modelling etc) (GUG263, TRCSD3).

Those students who were not considering a GIS-related career underlined two main points: the first was preferred career alternatives (such as teaching), and the second was a feeling that their background in GIS might not be sufficient to obtain a GIS job or do well in the GIS sector.

It was notable that whereas the UK Geography students saw their degree as potentially opening up a wide range of careers, the Turkish students still tended to see school teaching as very much the prime target area.

Among the eight Masters students, it was interesting that six wanted an academic career in HE, one wanted a school teaching career and only one wanted to work in the GIS job market. In part these results reflect the fact that in Turkey it is unusual for GIS Masters students to have a GIS-related job and to use the Masters to strengthen their formal GIS qualification. By contrast, it is common to see a GIS Masters as a stepping stone to a lecturing position, GIS being seen as an area of growing importance for the future. However, with a sample of only eight students, these findings must be treated with caution.

GIS lecturers' perspectives

Turkish GISLs believe that GIS skills will enhance their students' job opportunities. However, they draw attention to two main issues about the nature of the job market in Turkey. The first is that there is no government-recognized profession referred to as "Geographer" (except for Geomorphologists), and all jobs in governmental organizations are allocated by a centralized system (based on the results of an exam for governmental organizations; KPSS in Turkish). The second key feature is that the GIS job market is mainly occupied by engineering graduates and that geographers have only recently entered this area. Therefore, it can be difficult for Geographers to obtain GIS jobs in the face of competition from Engineers.

In spite of this competition, all of the GISLs believe that Geographers have opportunities in the GIS job market, particularly with some specific skills such as spatial analysis, analytical thinking and the interpretation of spatial data.

> Engineers are good at using analysis tools and databases, but they are not good at interpreting data. Anyone can learn how to use tools by pushing a button, but I think the most important thing is how to interpret and report what you have found (TRGISL11, TRCSD3).

As opposed to UK GISLs, three of the five TRGISLs emphasised that almost every year they receive demands from GIS companies to send them their best students.

> Since I started to work for this department, I have been sending between 1 and 4 people each year to GIS companies. However, this year I talked to 4 of our best students but none wanted the job. They would rather go to private-tutorial institutions as a teacher (TRGISL11, TRCSD3).

As their colleagues in the UK also underlined, the Turkish GISLs do have concerns that their modules do not cover sufficiently advanced level GIS skills. However, they do believe that their modules offer students GIS skills which are of significant value in the GIS job market. Their view is that much depends on the individual student and the particular post (this was true for both the Turkish and UK staff).

With respect to transferable skills development, two of the five Turkish GISLs emphasised that they are giving increased priority to improving their students' transferable skills, particularly team-working, oral presentations, and report writing. For example, one of the subject specific modules in TRCSD1 employs team-based reporting and assessment. Importantly, students taking this module prepare a project proposal for submitting to the Scientific and Technological Research Council of Turkey (TUBITAK) to get money for their project. This year (2011), five of the six groups' projects were supported by TUBITAK. This is a valuable experience for students.

> I'm particularly focusing on improving their team-working skills, so in the first class of the module I show them a figure outlining a group of people which are joined hand in hand, because it implies that you can't work alone (TRGISL11, TRCSD3).

One of the TRCSDs is offering an extra-curricular voluntary GIS activity in the form of a summer-term GIS-camp (which seems to be the legacy of a residential fieldwork collaboration with a UK Geography department). It is run in association with three other Geography departments across Turkey with help from TUBITAK. In this department some students enrolled for the GIS, primarily because it offered the opportunity of summer residential fieldwork, improving both GIS technical and general transferable skills such as teamwork.

With respect to employer links, an important advantage of having a departmental software licence (identified during the interview with one of the TRGISLs) was that it promoted personal contact with a GIS vendor company and resulted in some level of collaboration. One more reason behind such contacts, however, is the fact that the TRGISLs are not happy with the situation that the GIS commercial job market is dominated by Engineers.

One of the benefits of closer links to the professional GIS world is that some of the GISLs have a better understanding of the GIS job market in Turkey. TRGISL10 and 11 provide an informed synopsis of the position in Turkey:

> Currently in the GIS job market, there is little or no spatial analysis required. However, this issue is becoming important, so some city councils in future will expect skills in spatial analysis (TRGISL10 and TRPC4, TRCSD2).
>
> Companies expect us to teach students a special tool which allows City Councils to create the spatial features of the town (e.g. like creating a postcode system). Therefore, we are giving more attention to these kinds of consideration (TRGISL11, TRCSD3).

Another important outcome of contact with a GIS employer can be receiving feedback from both former students and their employers. In this manner, although TRGISLs underlined that GIS employers are generally happy with the level and background of their students (e.g. quick adaptation to job; TRGISL8), they did underline that Geography graduates often do not possess the necessary level of English:

> Employers complain about the level of language our graduates have got. They don’t want to employ students with a GIS background who have poor English, because so much of the GIS literature is in English (TRGISL11, TRCSD3).

Another part of the relationship with GIS companies is that some provide short training courses (typically lasting a week) which use Geography department lab facilities and target Geography students. The minimum fee is often about £50. Successful students obtain a certificate from the company. This is common practice amongst the Turkish CSDs. There are obviously advantages from these kinds of collaboration. One is that any job opportunity is directly drawn to the TRGISLs' attention (as underlined earlier). Second, companies may offer some discount or free licence opportunity to the department, in addition to paying a fee for using the lab for the short course. Third, they give some support to the departments' career days. For instance, one TRCSD has just started to organize a formal GIS career day for students. Companies send their Geography-background employees to this kind of event to encourage current students to think about a career in the GIS field. Career events can also have other "spin offs":

> On these career days I always invite my former students to talk to my current undergraduates and to explain the job they do, their salary etc. (TRGISL11, TRCSD3).

With respect to feedback from employers and former students, a clear message is the fierce competition which Geographers face from Engineers, with Geographers generally being good at the theory but sometimes struggling with the practice. One of the TRGISLs also recognized that ideally they would like to teach more advanced GIS:

> Some students ask me to teach some additional subjects such as Oracle, Arc Server, Geo database etc. But I think it is difficult to deliver these at Undergraduate level because of the students' background (TRGISL11, TRCSD3).

It is difficult to obtain information on the jobs students go into because Turkish staff do not have any system that chases up even their graduates' first destinations. However, they believe that each year typically 2-3 students from their GIS classes (say 5-10 percent) are getting a job in GIS companies or in Local Governmental Organizations where they use their GIS skills. However, students have to balance risks and benefits: jobs in the private market may be rather temporary (e.g. short-term contracts) when compared to teaching jobs (normally a permanent position) in government schools. One of the GISLs suggested that this is another main reason why the job market has been dominated by Engineers. Another obstacle is that, given Geographers' somewhat limited range of GIS skills, they may have to take low level posts, where the tasks are routine and the salary disappointing.

> My Geographers do a year with a GIS company but get fed up of data-entry type jobs and so switch into teaching. If they were more patient, they could get promoted to a more advanced GIS position and earn more money than teachers' (TRGISL11, TRCSD3).

Overall, the TRGISLs felt that there are many job opportunists for Geographers in the GIS market. However, there were concerns about what type of jobs are being offered to them, because some are only digitizing data and data entry. Students might think that they are over-qualified for this kind of work, but there can be opportunities to get promoted. The prevailing view was that a Masters was necessary to open up a senior position more quickly but that Geography graduates could make progress up the GIS career ladder if they were entrepreneurial and/or patient.

9.7.2 Employers' perspectives

This section offers insights into Turkish GIS employers (TRGISEMs) and also provides a review of GIS job ads (as was done for the UK in section 8.3.2).

As can be seen in Table 9.7, a total of 8 interviews were undertaken in 4 GIS companies/organizations. Although, in the UK, it proved difficult to obtain information in the public sector, it must be remembered that in the Turkish public sector there is a heavily centralised job allocation system based strongly on government entry examination scores. Moreover, the people interviewed in the survey were also knowledgeable individuals across the GIS sector. Their replies were assisted by information from a specialist area, normally Human Resources. The four companies chosen are among the biggest companies in their own field in Turkey with regard to both employee numbers and turnover.

Table 9.7: GIS employer participants in the Turkish GIS labour market

GIS Employers	Company Type / Position	Data Collection Method
TRGISEM7-8	Software Company: CEO and Manager/and Manager of HR Office	Face-to-face Interview
TRGISEM9-10	Software Company: Project Manager and Manager of HR Office	Face-to-face Interview
TRGISEM11-12	Consultancy Company :General Project Coordinator and Project Manager	Face-to-face Interview
TRGISEM13-14	Consultancy Company: CEO and HR Officer	Face-to-face Interview

As can be seen in Table 9.8, the companies' total employee numbers varied from 110 to 300. It seems that the leading Turkish GIS companies are generally rather smaller than those in the UK, the GIS sector overall in the UK being much bigger than in Turkey (although the Turkish growth rate seems to be much faster than that in the UK-partly because the GIS sector is a relatively new market in the Turkish economy, whereas it has a long history in the UK). It is important to emphasise therefore that the Turkish GIS market has the potential to produce substantial numbers of future GIS jobs: this was certainly the view of the interviewees.

Table 9.8: Information about the employees in the Turkish GIS companies

GIS Company	The number of all employees	The number of GIS specialists	The number of Geographers	The principal background of GIS specialists
GIS Vendor-1	160	45 (28%)	8	Geodesy and Photometry Engineers, Geology, Town Planning etc.
GIS Vendor-2	190	70 (37%)	3	Town Planning, Mine Engineering, Computer Science, Environmental Science
Consultancy-1	110	30 (27%)	0	Computer Engineers
Consultancy-2	300	20 (7%)	2	Geodesy and Photometry Engineers, Environmental Engineering, Town Planning

Short-term contracts are common in the Turkish GIS labour-market (up to 25 percent of the workforce). This may principally be because the sector in Turkey is still new and therefore the big companies are also doing the job of small specialist businesses such collecting data and creating geo-database. Thus, these types of people are employed for particular projects on short-term contracts. Even so, most GIS specialists are employed on permanent posts. The following quote might help to explain the reason behind this:

> There is a shortage of experienced personnel in the GIS sector and so to avoid recruitment problems we prefer most of our specialist staff to be on permanent contracts (TRGISEM9).

The ratio of GIS specialists to all employees in the GIS companies varies from 7 percent (Consultancy Company) to 37 percent (GIS vendor). However, the number of Geographers amongst all employees is tiny (max. 5 percent, as shown in Table 9.8). This clearly confirms the earlier discussions about the very small role of

Geographers in the GIS sector. This finding also supports the results of Demirci and Kocaman (2007). They found a total of only seven Geographers within 13 Turkish GIS companies. Most of the GIS specialists tend to have an Engineering background, principally in geodesy and/or photogrammetry. More recently Geomatics seems to be a leading degree background amongst the Engineers, this being followed by subjects such as Geology, Town Planning, Environment, and Mining.

It was interesting that the employers did not necessarily think that a Masters degree is important. They think that a good first degree level is generally enough. However, their degree preference is generally towards Engineering, and any relevant Engineering subject is considered desirable. However, this can be variable depending on the focus of the particular project: for instance, if a project is dealing with mining, they might prefer someone with a geology background.

When looking at the relationship between employers and the HE sector, primarily Universities have a customer-type relationship. For example, the GIS Vendors' main relationship with HEIs is based on selling licences, providing training, and sometimes data and training documents (tutorials notes and exercises). Additionally, as in the UK, these companies also provide a limited amount of sponsorship and workshop and seminar activities for Universities. One of the TRGISEMs underlined that they currently have a relationship with one of the private Universities (in Istanbul) which takes the form of helping to establish a Masters programme in GIS. However, the dialogue between TRGISEMs and Geography departments seems to be essentially limited to a few departments which are using company products, the GISEMs' primary HE contacts being most certainly with Engineering departments.

GIS skills and specialisations

The most common expectation is that new graduates should be able to use at least one major piece of GIS software and have a basic general understanding of GIS. However, requirements do vary according to the projects or types of the job being undertaken in the company. The TRGISEMs were typically looking for potential candidates who could be trained by the company and who would learn quickly. They often emphasised that it is not easy in Turkey to find the right person and the short history of the GIS sector means that there are not many experienced people in the job market. Thus, companies mainly employ people whose skills can be sharpened up or re-oriented. Nevertheless, a few TRGISEMs underlined they were currently looking for some specific skills such as spatial databases (mainly Oracle), and/or a programming language (such as SQL, Python or Visual Basic).

Given that GIS skills can be developed within a company, transferable skills are considered important when choosing new staff. As indicated above, the TRGISEMs are looking for people who will stay within the company for a long time and who have the skills to be adaptable and the ability to learn quickly. The skills they are mainly looking for amongst the candidates are preferably a good level of English, analytical thinking, flexibility and adaptability, a willingness to keep abreast of the new technologies (related to the need for good English), project management, team-working, problem-solving and communications skills.

> To learn quickly is important, because their University education process is not sufficient to allow graduates to start immediately in the real working environment (TRGISEM9).

It should, nevertheless, be emphasised that the relative importance of the skills identified above will vary according to the job within the company. For instance, in the selling team, communication and presentation skills can be more important, while the project-coordinator/manager position requires having a good level of team-working and project management.

Overall, employees should have skills which allow them to learn new things and to keep up with developments in the world of GIS. It seems that there are three main reasons why companies often look specifically for Engineers. The first is that Engineers are thought to be more practical, more quantitative and more project-oriented. The second is that GIS posts are largely filled by Engineers who then appoint other Engineers rather than applicants from less familiar disciplines such as Geography. The third reason is the level of foreign language which seems to be the major handicap for Geographers. In Turkey, there are only two Geography programmes (one of them in a private university) which offer English preparatory classes to their incoming students. By contrast, most of the Technical Universities (METU, KTU, and ITU) provide compulsory English classes and additionally for some of the Engineering programmes' the actual teaching language is English. This makes a significant difference in terms of GIS employability in favour of Engineers' backgrounds.

Jobs and skills trends in the GIS job market

The TRGISEMs stressed that job opportunities in GIS are growing, at least at a moderate pace. This growth is mainly driven by the need to service public sector projects. In addition, the adaptation of Turkish GIS infrastructure to EU conventions and practices is an important factor (e.g. INSPRI project[22]). Another source of demand is the trend towards smart phone applications and web-based GIS.

Looking to the future, they all agree that jobs in GIS will continue to grow. The majority of the GIS companies in Turkey seem to be following overseas trends

[22] Please visit http://inspire.jrc.ec.europa.eu for further information.

(especially in the US and the UK). For example, one of the TRGISEMs is particularly interested in GIS applications for Royal Mail in the UK, and is proposing similar developments in Turkey (TRGISEM7).

Overall, when the TRGISEMs were asked to what extent they are satisfied with Turkish HE, most of those interviewed indicated the ‘slightly dissatisfied’ or at best ‘satisfied’ level. The lack of strong and close relationships between the sector and the universities was widely given as the main reason for this. Additionally, a lack of “real-world” teaching was also raised. On a more positive rote, the TRGISEMs seemed willing to work with Geographers, not least because they believe that Geographers are good at spatial analysis, map reading and cartography. Concerns remained about Geographers’ lack of experience in “real world” projects and their level of foreign language skills (especially English). Finally, they believe that Geography departments are mainly focussed on academic education rather than the more vocational aspects of the discipline. Geography has an image of being more strongly connected to school teaching then to the worlds of business and government (see Seremet and Chalkley 2012).

9.7.3 The review of GIS job advertisements in Turkey

A total of 127 job ads were collected (from September to August 2011) from two of the most popular job online agencies (kariyer.net and Secret CV). The results showed that there are three different types of jobs in Turkey echoing the pattern seen in the UK (see section 8.3.2). Before starting to provide a detailed analysis of the GIS job ads data, it is useful to highlight some broader aspects of the Turkish GIS job market.

The first thing is that although national and local governments are producing large amounts of GIS work, much of it is being undertaken by private consultancy companies, who are in effect employing staff on behalf of the government. However, in the analysis presented here, many government-oriented jobs have had to be excluded, because they employ their staff via central placement and use the title of the profession they would like to employ (Engineer or civil servant) rather than the particular responsibilities of the jobs. The second issue is that some companies in the GIS sector are employing people via their own CV-database system and so at least some of their jobs did not feature with the two online agencies used in my analysis.

Regarding the job types, type-1 job represent 14 percent of the total job ads classified: however, it should be pointed out that this first type is just slightly different from the one in the UK (Table 9.9). It is mainly jobs for people who have good general computer literacy skills (see section 8.3.2). Jobs within this type are mainly related to data collection and data producing processes (e.g. Data Technician and Topographical Surveyor).

The second category accounts for 39 percent of the total job ads. Typical job titles are Project Coordinator, Sales Executive and GIS Training Consultant. As we know from the UK, Geographers seem potentially well qualified for these kinds of jobs, yet in the case of Turkey, the qualification requirement is almost always Engineering, with a Geography degree background rarely mentioned. With reference to the expected transferable skills, these are mainly written and oral communication skills, team-working, a good level of English, and a capacity for adaptation and flexibility (Table 9.9).

The third job category, with 47 percent, is the largest group in the job ads (Table 9.9), as it is in the UK. These types of jobs often require programming languages and an advanced level of GIS skills. Job titles include Software Developer, and Software Designer. Geography is hardly referred to amongst these kinds of jobs ads. This is disappointing, but when looking at the GIS provision run by Geography programmes, it is unlikely that Geographers on graduation can genuinely be qualified for these kinds of jobs. Nevertheless, Geographers who improve their technical skills may be suitable in the subsequent stages of their GIS career. With respect to transferable skills, these types of jobs also need the skills listed earlier, such as team-working and a good level of English, but at a more advanced level.

Table 9.9: GIS Job Typology in Turkey

Job Types	Technical Typical Requirements	Typical Transferable Skills	Typical Degree Requirement
Type-1 (GIS-supported job) (e.g. Digitizing, Data Entry, Data Collection)	• Very basic understanding of Geographic information system and spatial data	Computer-literacy	Diploma/Associate Degree in Cartography or Topography
Type-2 (GIS Consultant, GIS Officer, GIS Project Coordinator, Training Manager)	• Geographical Information background with basic or medium level spatial analysis skills (e.g. suitability analysis, site selection)	Communication Team-working English Project Management Reporting skills Analytical Thinking Keeping up to date with the on-going changes in GIS technology	Engineering Degrees Town and Planning
Type-3 (GIS technician, GIS/Developer/Web Developer/ Engineer/Application Developer, GIS Specialist etc.)	• Programming languages • Web-based GIS • Database Management	Problem solving English Team working Presentation Report writing Being Analytical with close attention to detail Keeping up to date with the on-going changes in GIS technology	Engineering Degrees Geomatics Computer Engineering Town and Planning

When considering both the TRGISEMs and the job ads findings, Geography degree leavers appear potentially qualified for jobs classified in type-2; but overqualified for type-1 posts. In spite of this, some Geographers are employed for type-1 jobs in the first instance. This over-qualification issue might be the main reason why many Geographers are not interested in a GIS career. The analysis of the Geography curriculum suggests that type-2 jobs are roughly equally suited to Engineers and Geographers, but the figures in the companies showed the present overwhelming dominance of Engineers. It is also possible that the lack of reference to Geography within the job advertisements is an important reason for Geographers not applying. Although type-3 jobs require some level of programming language and web-based applications, the case study MSc programme does not appear to be sufficiently focused on these areas or on preparing students for these kinds of jobs. By contrast, there are some other Masters programmes in GIS mainly run by Engineering departments which may prepare their students much better for these kinds of posts. Computer Engineers might thus be the most suitable group which could be employed for type-3 positions. For instance, Ercan and Komesli (2008) revealed that advanced GIS skills are to a large extent covered by modules which are taught in the Computer Engineering Programmes of Turkey. Finally, in discussing employability issues, it must be remembered that one reason why Geography does not feature strongly in GIS jobs and job ads is, of course, that at HE level it is a tiny discipline. It therefore lacks the profile of much larger disciplines, such as Engineering and this makes it more difficult to make a major impact on the GIS jobs market.

9.8 Synthesis, Evaluation and Comparison between Turkey and the UK

As with the previous results chapters, this closing section provides a brief summary and reflective commentary. However, a major difference in this case is the emphasis given to comparisons between Turkey and the UK and to highlighting points of similarity and contrast.

In this respect it is important to state that in both countries, Geography-based GIS provision, teaching and employability obviously reflect their wider national contexts with regard to both Geography and the HE system as a whole. For example, Turkey is trying to make major changes to align with the Bologna process and as a result steps are being taken to strengthen HEI’s quality assurance systems. These will obviously affect Geography and GIS students and staff. Nonetheless, at present (as this chapter has shown) some aspects of quality assurance well established in the UK are missing or less well developed in Turkish courses, such as Intended Learning Outcomes, student handbooks and student-based teaching evaluation procedures. There is no equivalent in Turkey to the UK’s National Student Survey or to the staff training courses often led by educational development units. It is also important to recognize that Geography as a subject-base for GIS is a smaller and less powerful HE discipline in Turkey. Although the total number of HEIs is similar to the UK, Turkey has only one-third the UK’s number of Geography departments/units. Nonetheless, Geography as a degree is strongly committed to GIS and almost all of Turkey’s Geography courses include one or more GIS modules. Moreover, they are much more likely to be compulsory them in the UK. However, Turkey has only two Geography-based GIS Masters and there are no full undergraduate degrees in GIS.

The GIS teaching in Turkish case-study departments, as in the UK, is delivered mainly by physical geographers. They typically have overseas HE experience and this, plus GIS textbooks, play a key role in curricula design. It is noticeable that the GIS curricula in Turkey give more emphasis to data production and creation issues, this resulting from the low level of data provision and availability in Turkey compared to the UK.

In Turkey curriculum delivery relies even more than in the UK on traditional teaching methods and principally on lectures. This is because some modules are entirely theory-based because the student:staff ratios are very high and because staff are not trained, or particularly encouraged, to be innovative in their teaching. In addition, staff are promoted (even more than in the UK) on their research publications and perhaps less inclined therefore to prioritise teaching. All this reinforces conventional lecture-centred rather than student-centred teaching and the survey results confirm Seremet's (2008) conclusions that in Turkey traditional teaching methods are dominant in Geography (although Geography is by no means unusual in this respect). This appears to be the case at both undergraduate and Masters level. Nonetheless, the teaching I observed (although rather didactic) was clearly organized and the staff were committed and positive. Moreover, in the TRCSDs the student satisfaction scores were only a little lower than in the UK-despite the frequent complaints about too much theory (see Table 9.10). Using more practical teaching was difficult in Turkey because of lab sizes and the reluctance to avoid repeat sessions (teaching contact hours were already high). The small labs also meant that student numbers on GIS options had to be limited and that it was common for students not to be allowed to enrol because the option was full. Another problem for Turkey was the lack of institutional or at-home-use licence – and sometimes licence for industry-standard software.

Table 9.10: A comparison of the key findings from the Geography GIS modules surveys (Turkey and UK)

Key issues	TURKEY	UK
Assessment helped learning	53%	70%
GIS always or frequently used more widely	14%	6%
Met Expectations	46%	54%
Students satisfied	70%	77%

With respect to Masters teaching, although there were only eight students in the survey, it seemed that many of the undergraduate findings also applied. Although some of the practicals were more interactive and student-oriented, lectures were still dominant. Traditional methods were also the majority in assessment at Masters as well as undergraduate level.

In relation to transferable skills and employability, it was noted that both undergraduate and Masters students generally felt that the GIS teaching had only a minor effect on their transferable skills (not surprising given the dependence on lectures). This may also result from the fact that the employability agenda is not yet firmly established in Turkish HE. More undergraduates than in the UKCSDs were interested in GIS jobs, perhaps because it appeared as one of the few career alternatives for Geographers apart from school teaching. It was rather curious that only one of the eight Masters students was firmly committed to working in the GIS sector. Five were hoping to use the course to help them got an academic post However, with such a small sample, it would be unwise to conclude that these career plans are typical of Turkey's GIS Masters students.

To help understand the needs of GIS employers, a small group of them (eight from four companies) were interviewed. Their requirements focused on areas such as creating vector data and running spatial analysis techniques. This was rather different from the UK where there was more emphasis on advanced GIS skills such as web-based GIS and mobile technologies, although the Turkish market is also starting to head in these directions. Both in Turkey and the UK employers also stressed the importance of transferable skills such as team-working, adaptability and the capacity to learn new skills quickly and keep up to date. The Turkey employers also stressed the importance of candidates having a good ability in English language.

An analysis of GIS job adverts in Turkey led to the identification of three categories (basically similar to the UK), requiring either basic, medium-level or advanced GIS skills. The top category (type-3) was generally suitable only for Masters-level GIS graduates. Although many Geography graduates who have studied GIS modules would have enough GIS expertise for type-1 and 2 jobs the great majority of these posts were filled by Engineering graduates with Geographers occupying typically less than five percent of positions in GIS companies. Very few job adverts even mention Geography as a suitable qualification. The reason for Geography's underperformance in the GIS labour market probably relate mainly to the discipline's small size (compared to Engineering) and to the traditional perception of Geography in Turkey as being essentially a route into school teaching. The next (and final) chapter includes, amongst other things, a set of recommendations which derive from the thesis research, some of which relate to improving the ability of Geographers to compete successfully for GIS posts, particularly in Turkey but also in the UK.

CHAPTER 10 : SUMMARY, RECOMMENDATIONS AND REFLECTIONS

10.1 Introduction

This final chapter is structured into three sections. The first part brings together and summarises the key findings of the thesis. The second provides recommendations for the improvement of GIS education in both the UK and Turkey and also some suggestions for further research. The chapter ends with a reflective section that considers how far the thesis has accomplished both the research aims and also my personal goals, as set out in the opening chapter.

10.2 Summary

In this section, some of the principal findings of the research are outlined by focusing on the key aims of the research in the areas of provision, pedagogy and employability. The discussion focuses first on the UK and then on Turkey and then on some points of similarity and contrast. Given that there has already been a synopsis section at the end of each results chapter, this final overall summary is deliberately brief.

In the UK, Geography-based GIS provision is characterised by module level provision within Geography undergraduate courses (more than 90 GIS modules), by specialist undergraduate GIS programmes (7 UG GIS programmes) and by GIS Masters programmes (22 Geography-based GIS Masters). All these three types of provision were also represented in the case study departments where 6 Geography, 3 Masters and one UG GIS programme were studied. The main data sources used were interviews with staff, a questionnaire survey of GIS students and documentary sources such as programme and module handbooks.

All the case study GIS provision benefited from up-to-date curricula and from the opportunities offered by technical and software facilities such as VLEs, CHEST and Digimap and normally well-equipped computer laboratories. However, the amount of technical support staff in the departments was often felt to be insufficient. Additionally, with respect to curriculum provision, one of the weaknesses in UG Geography provision is the common lack of progression in GIS and its isolation with the curriculum. Insufficient progression means that it is rare for the GIS provision and teaching to span all three years of the degree. Typically, there is just a little introductory GIS teaching in 1st year, an optional GIS module in the 2nd or sometimes 3rd year and a small number of students use it in their dissertation. There is little use of GIS outside of the GIS modules. These findings support the survey results of Gedye and Chalkley (2006) and Brown (2004) that there is overall insufficient attention given to GIS in Geography programmes and that many former students consider that, with hindsight, they wish they had more exposure to GIS, not least because of the its potential employability advantages. Given that most GIS provision in Geography degrees is optional, at present the great majority of Geography graduates have only a very limited knowledge of GIS and its applications, which seems curious at a time when Geography as a discipline is seeking to strengthen its employability credentials.

The existence of a large number of MSc programmes is one of the main differences between UK GIS provision and that in many other countries (including Turkey). Recruitment to them often includes graduates from other countries (sometimes distance learning). However, in the near future intake numbers in Masters provision might be affected by rising tuition fees and by the government’s visa policy for overseas students. In future, therefore, recruitment could be worrying for some

Masters programmes, as illustrated by the recent closure of one of three Masters courses in this case study. It is also worry that the case study GIS undergraduate programme has also recently closed as a result of poor recruitment.

Regarding pedagogical approaches, there is mixture of modern and traditional practices in all three types of provision. Traditional approaches were strongly represented by lectures and formal unseen examinations, although student-centred approaches and coursework assignments were also used, particularly for practical work. The delivery of GIS theory emerged as a critical issue in that most students see the theory as less valuable, less relevant and taught in lectures which are not sufficiently interactive. These results were similar to those which Whyatt et al. (2011) found from their alumni survey. Moreover, a coursework approach is still not much used in assessing the theory part of the curriculum, despite the importance of linking skills development with assessment (Haigh and Kilmartin 1999).

There was little evidence of external or internal support for CPD being used for the improvement of GIS teaching, although many organisations have been available in this area. It was of particular interest that the GIS staff generally knew little if anything about the SPLINT CETL which, in the case study departments, at least, appeared not to have had an impact on the curriculum or the teaching. This result is consistent with the final review report across the CETL programme nationally (HEFCE 2011). Nevertheless, the overall satisfaction of the UK GIS students seemed to be encouraging, with 77 percent satisfied. This also supports the findings of Clark and Higgit (1997) that Geography students tend to be satisfied with their modules and programmes and it reflects also the fact that Geography as a whole generally receives good scores in the National Student Survey (NSS) (White 2010), indeed, often higher than the 77% satisfaction figure found for GIS modules in this research.

With respect to employability, interviews with a sample of GIS companies indicated that there seems to be at least stability or at best some growth in GIS jobs, especially in web programming, desk-top coding and open-source software. Additionally, employers are often looking for business/marketing expertise alongside GIS skills. UK undergraduate Geography provision seems to be meeting the sector's needs at least at a basic level, particularly if graduates' transferable skills are well developed. These findings, including the importance of transferable skills, are also in line with what Brown (2004) and Whyatt et al. (2011) found from their alumni surveys. With respect to employability it is, not surprisingly, Masters level provision and full UG GIS provision that seem to be more relevant and promising both for the current situation and for likely future trends in the GIS job market. This is all the more so because more specialist modules can be offered to cover the most wanted skills (especially dealing with programming language and web GIS). Nevertheless, almost half of jobs advertised in the sector require skills which can be learnt from the typical GIS Geography modules. Across all three types of GIS provision, however, employability could be improved by strengthening the connections between academia and employers, which are currently only patchy. The same is true of alumni who are another underused resource.

In Turkey, there are only two different types of Geography-based GIS provision: GIS modules in Geography programmes and GIS Masters programmes. However, the number of Masters programmes is much less than in the UK, there being only two GIS MSc programmes based in Geography departments. Moreover, there are no GIS UG courses at all. One major difference in Turkey is the amount of GIS provision in other disciplines, particularly Engineering. Geography is only a relatively small contributor.

More positively, GIS modules within Geography undergraduate programmes in Turkey seem to be well established in all departments and more likely to be compulsory than in the UK. However, there is an even stronger emphasis on theory which students do not welcome. Moreover, Geography-based GIS education in Turkey remains hindered by resource shortcomings (e.g. lab spaces and software packages). In addition, there is a lack of publically available environmental and socio-economic data for practical exercises and projects.

Pedagogical approaches are more conservative than in the UK: even practical classes involve a substantial amount of lecturer-oriented approaches, while project-based learning was rare. Although the curriculum content at both undergraduate and Masters levels was generally similar to the UK (many of the Turkish staff had previously studied GIS in the USA or the UK) the teaching and assessment methods were usually more traditional. For example, although there was often a GIS module in the first year of Turkish Geography programmes, it was always focused on theory and lecture-based. Later GIS modules often had more practical work but still less than in the UK. Nevertheless, the overall students' satisfaction rate at 70% is only a little below that in the UK. Although GIS teaching is less varied and less student-centred than in the UK, outside the first year there is often at least some practical teaching which in other modules is less common than in Britain. This shows that GIS is still somewhat different from other Geography modules in its teaching methods.

GIS jobs in the labour market have been increasing in Turkey partly because of government-led attempts to align the spatial information technology infrastructure with the EU. Many of the projects are funded and initiated by the government sector but are actually undertaken by private companies. As opposed to the UK, GIS jobs in Turkey are being mainly occupied by Engineers. The foremost employability area for Geographers is teaching at government schools and private tutoring institutions which are generally preparing their students for university entrance exams (Seremet and Chalkley 2012). GIS employers in Turkey often look for a good level of English and business and marketing skills, in addition to GIS skills. Engineering courses, having first pioneered GIS education in Turkey, often provide this set of graduate characteristics. As a result, most posts are filled by Engineering graduates, with Geographers occupying less than 5% of positions in GIS companies.

Overall, in both the UK and especially in Turkey, Geography is not capitalising sufficiently on GIS (compared with the USA). GIS typically exists in isolation, needs to be more prominent in the Geography curriculum and to be more widely featured in other Geography modules in both countries. In Turkey, Geography is in a way hampered by its strong association with school teaching which has led many of its students to neglect other kinds of careers. In both countries, GIS employer and academia links need to be stronger in order to enrich teaching and raise awareness of job opportunities. Finally, the two countries can learn from each. A case should be made for GIS to feature in the recent Anglo-Turkish HE collaboration agreement signed by both governments (for details please see http://www.worldbulletin.net).

10.3 Recommendations

10.3.1 Recommendations for Geography departments

The recommendations below are underpinned by the research undertaken for this thesis and fall into three sets. The first set applies to both countries, the second is focused on UK Geography departments and the third is directed at Turkish

Geography departments and their HEIs. Before presenting these proposals, however, it is important to acknowledge that GIS teaching and learning at both undergraduate and Masters levels already has lots of strengths and that certainly student satisfaction levels are generally encouraging. However, as the recommendations below indicate there is much more that could be done.

General recommendations for both countries' Geography departments:

- The importance of GIS should be fully recognized by Geography departments. This is in part because of its academic value for studying Geography and in presenting, analysing and explaining geographical patterns. In addition, GIS is means of developing students' general IT literacy. It is also important that Geography enhances its employability credentials and GIS represents one careers sector (likely to grow in the future) in which Geographers should often be able to compete successfully. The discipline should certainly be mindful of the observation by Koutsopoulos (2008, p.8) that in future Geographers "will be in the information business (or in no business at all)".
- GIS should therefore be given an appropriate status and role in the curriculum. This should ensure that all Geography undergraduates achieve at least basic standards in GIS. This PhD has shown that in the UK a majority and in Turkey a sizeable minority of Geography students receive little or no education or training in GIS. There should also be opportunities for more advanced and specialist study in this field. The curriculum should therefore be carefully planned and progressive with a taster experience in year one followed by more advanced or specialist modules in later years.

- Some of the growth sectors in GIS will favour graduates with a background in programming language, web-based GIS and mobile technologies. Geography departments may wish to consider whether to provide more specialist teaching in one or more of these fields.
- In so far as resources permit, provision should be made for students to select for study different kinds of GIS applications according to their particular interests, for example, in physical and/or human geography.
- The relevant staff should be encouraged and supported to develop their expertise in GIS curriculum design and pedagogy. Appropriate CPD opportunities should be provided and staff encouraged to take part. At present the evidence suggests that very few GIS staff engage in CPD designed to enhance their teaching.
- The constructive alignment approach (Biggs 1996) should be employed, with Intended Learning Outcomes (ILOs) being used to link and give coherence to teaching, learning and assessment methods. This PhD findings suggest that staff need more support in this area, particularly in Turkey, and especially in order to distinguish between different cognitive levels. For example, the expected achievement at undergraduate and Masters levels needs to be more clearly differentiated. Students also need to be made more aware of the key roles of ILOs. These messages may well apply to other subject areas too but this research shows that they are certainly relevant to GIS. Baume's work (2009) can be a good guide on this for all academics.
- Students in both the UK and Turkey are critical of the amount of teaching devoted to GIS theory. Lecturers should therefore explain still more clearly the

purpose and value of GIS theory so that students are in a better position to appreciate its importance and the reasons for studying it. This would be valuable educationally and also reduce a major source of student complaints.

- This research has shown that at present GIS is often confined to the designated module(s). Efforts should be made to reduce this isolation and to encourage the wider use of GIS in other parts of Geography programmes. Some CPD for non-GIS specialists may be needed to advance this. Students should also be encouraged to use GIS in their dissertations.
- GIS teaching at both undergraduate and Masters levels should be reconsidered in the light of a better understanding of what employers are looking for and current and expected trends in the GIS job market. It must, of course, be recognized that some of the advanced technical skills valued by employers are perhaps best taught at Masters level or indeed in computer science departments. Nonetheless, it is essential for Geography to appreciate that in future employability will be increasingly important for recruitment at both undergraduate and Masters levels, not least because in the UK there is already evidence of GIS course closures through insufficient recruitment.
- The research has shown that at present there is often only limited contact between GIS academics and GIS companies and employers. This is true for both undergraduate and Masters courses. These links should be strengthened to encourage regular discussion about recent developments in GIS and about changing employment trends and requirements. Where possible, employers should be included in curriculum design, the teaching and learning process and in offering careers advice. The same is true of alumni – an underused

resource. Past students can tell their story and promote the idea of working in GIS.

- Where possible, students should be encouraged to obtain professional experience in GIS, for example, as part of a work-based learning module or another type of placement. Shepherd (1995) has some useful guidance on this, but at present it seems that this kind of arrangement is very rare.
- The research evidence in this thesis indicates that to enhance employability for both undergraduate and Masters students, it is important to develop their transferable skills as well as their GIS expertise. The student survey results suggest there is scope to do more in this area, particularly through GIS practicals, project work and guest speakers.
- Fieldwork-based approaches should be part of the GIS teaching (see Carlson 2007) where possible. Similarly, more use should be made of GIS in other fieldwork across Geography. Despite a growing literature in this area (see, for example, Guinness 2012, Wall and Speake 2012), there was not much evidence of GIS being used more widely across different types of fieldwork.
- Consideration should be given to reducing the assessment role of formal examinations, particularly for GIS modules with a practical dimension and where this kind of assessment does not match closely to the ILOs.

For UK Geography departments:

- Given that in future more GIS is likely to be taught in secondary schools, GIS academics should consider the implications and the opportunities this might create.

- Although technical infrastructure provision seems generally to be strong, Open Source materials and software need to be part of the GIS teaching. In so far as finances allow, it is also important to ensure that academics and students benefit from appropriate levels of technical support staffing.

- Geographers should be encouraged to make links with GIS academics in other disciplines in order to foster interdisciplinary and so they can learn from each other.

- Doing research in pedagogical subjects and enrolling in pedagogic development programmes should be encouraged. At an early stage in this process staff should at least engage with the ideas and resources of the SPLINT Centre for Excellence in Teaching and Learning (www.splint-cetl.ac.uk) and consider particularly the teaching related work of the RGS-IBG Research Group on GIScience.

- The GIS part of the Geography QAA benchmark statement should be revised, taking suggestions from relevant HE academics, employers, the Quantitative and GIScience research groups of the RGS-IBG and from the AGI. The QAA benchmarks as a whole are soon to be reviewed and this will provide an opportunity for GIS to achieve a higher profile and stronger position with the discipline.

For Turkish Geography departments;

- In Turkey the discipline of Geography and its HE departments need to review carefully what steps can be taken to position GIS more strongly within Geography and above all to raise the discipline’s profile and standing in the GIS field – relative to discipline such as Engineering.

- Consideration could be given to designing a small part of GIS teaching to assist potential secondary school teachers, this being by far the largest employment area for Geography graduates. This would help ensure that school pupils (and their families) see GIS as important and as a natural and integrated part of Geography.
- Where possible and resources allow, the infrastructural challenges focussing on HE GIS, such as lack of home-use licences and dedicated labs, need to be addressed. Similarly, the systems covering projects such as Digimap and a CHEST-type of project should be available for all teaching purposes.
- Spatial data provision in Turkey needs to be reconsidered, with a view to making key environmental and socio-economic data sets more widely available for teaching and research purposes. As a discipline, Geography needs to lobby the Government on this, in collaboration with others.
- The methods used to teach GIS in Turkey should be more varied, with greater use made of active learning and student-centred approaches. Where lectures are needed, these should be more interactive and less passive (see Schultz 2011 for a brief guide).
- The GIS academics in Turkey need to benefit from publications, ideas and teaching resources which are available internationally. If necessary, with the permission of the licence agreement, these materials should be translated into Turkish.
- Geography departments and their GIS staff should encourage the Turkish Geography Associations to consider setting up a GIS study/research group,

part of whose brief would be to promote GIS teaching at both HE and secondary school levels.

- With respect to promoting employability, Geography departments should consider not only strengthening students’ transferable skills and business awareness, but also their students’ command of English. The Turkish employers interviewed for this research, made it clear that this is of particular importance for jobs in GIS.

It is, of course, fully acknowledged that a number of the above recommendations have resource implications and that there are always competing pressures on budgets and on staff time. Moreover, in some cases, the proposed changes may be difficult to produce without support at institutional or governmental level. Nevertheless, it is hoped that these recommendations will inform discussion and provide an agenda for change and, in particular, for enhancing the students’ learning experience in GIS.

And finally, before outlining recommendations for future research, it is important to highlight some broader lessons identified during this GIS research which the two countries might learn from each other (in addition to the details in the recommendations above). For UK Geography, perhaps the principal general lesson is that it should not be taken for granted that the discipline is the only possible main ‘home’ for GIS teaching. In the UK, Geography is by far the leading discipline for GIS, but in Turkey Engineering dominates, with Geography playing only a minor role. UK Geographers should therefore not be complacent and must actively seek to ensure that the discipline works energetically to enhance GIS education and to earn its leading role.

For Turkish Geographers, by contrast, the main lesson is that the discipline does not have to be limited to a minor role and that it needs to work actively to raise awareness of its capacity to make a bigger contribution to GIS both in education and in the workplace. This needs to be part of a wider movement to promote the idea that Geography graduates do not have to work in teaching (important though this is) but that they have knowledge and skills which can be used in many different sectors and professions. In the UK Geography has had considerable success in promoting this wider employability agenda and Turkish Geographers could benefit from studying closely the UK example. Turkish Geographers should also be encouraged by the USA example where Geography, despite being a very small discipline, plays a major role in GIS education and the GIS sector and where the discipline has certainly benefited from the dynamism and the profile injected by GIS (Murphy 2007).

One final set of lessons which Turkish Geographers, and other academics, are recommended to examine is the UK's more strongly developed procedures for HE quality assurance and enhancement. These include, for example, module and programme evaluation procedures, peer observation of teaching, student satisfactions surveys, student handbooks and guides, grants for curriculum innovation, CPD opportunities for staff and promotion systems which (to various extents) reward and encourage high quality teaching. Perhaps Turkish Geographers might wish to take a lead in encouraging their HEIs to look at the UK experience (and that of other countries) and to pilot, promote and strengthen these kinds of processes.

10.3.2 Recommendations for further research on GIS education

Although this research has addressed many issues dealing with the provision and quality of the Higher Education provided in the field of GIS, there are still many important questions which could be of interest for new researchers who want to do work at HE level in this field. These could include, for example:

- What is the precise scale and nature of GIS provision within other disciplines? How does this compare with Geography and what could these various disciplines learn from each other?
- What are the differences between face-to-face MSc programmes and Distance Learning programmes in GIS? What kinds of issues might arise if Distance Learning in this field is to grow? Does face-to-face GIS MSc teaching have a sustainable future?
- What factors have shaped the detailed historical evolution of HE GIS provision?
- What is the scale and nature of GIS provision in other parts of the world, particularly in developing countries? (The existing literature remains very Anglo-American.) How and why does GIS education vary from country to country?
- With respect to alumni now working in the GIS field, what are their views on the quality and effectiveness of their GIS education? (In particular, there is no existing research on this in Turkey.)
- What lessons can other countries, such as the UK and Turkey, learn from the USA experience where GIS features much more prominently in geographical education?

10.4 Reflections

10.4.1 Academic reflections

With the benefit of hindsight, here in this section, the general aims of the research, as summarized below, are briefly discussed with respect to how far they have been accomplished.

- To review and critically evaluate the role, scale and nature of HE Geography in provision of GIS education.
- To explore and explain issues relating to the curriculum and the pedagogical aspects of GIS.
- To assess the extent to which GIS teaching is meeting the demands of professional practice and GIS employers in the UK and Turkey.
- To make recommendation intended to enhance the quality of GIS educational provision and practice.

For the achievement of the first aim, a web-based methodology plus a document analysis was used. This approach succeeded in identifying different types of Geography-based GIS provision and the number of relevant programmes and modules both in the UK and Turkey. While it must be acknowledged that these data provide only a “snapshot” at a particular point in time, it is unlikely that the basic patterns will change quickly or very substantially. Some commentary was also provided about the explanation for the patterns of the provision identified, although no attempt was made to provide a detailed history of the evolution of GIS provision – a task which lay beyond the scope of this thesis but which could be interesting for others to pursue.

The second aim has taken this thesis beyond a basic account of GIS provision and into issues of pedagogy, and issues of not only how GIS is taught but how well it is taught. The evidence base here was centred on 10 case study departments (6 in the UK and 4 in Turkey) and on over 300 student questionnaires, 16 staff interviews and 14 classroom observations. Although the surveys in both the UK and Turkey found quite high levels of student satisfaction, nonetheless a number of issues and problems were identified, several of which form the basis for the recommendations made in section 10.3. Although the evidence on pedagogical matters rests on some 10 CSDs, they were chosen with care to be a reasonably balanced cross-section. The intention was to provide richer insights into GIS teaching and the student experience rather than to build comprehensive generalizations about the GIS work of UK and Turkish Geography departments. Nonetheless, there is no reason to believe that the findings are likely to be seriously atypical and discussions with experienced GIS colleagues in the UK and Turkey confirm my confidence in the value of the pedagogic data collected.

Nevertheless, no claim is made that the review of GIS pedagogy is perfect. For example, no use was made of student focus groups or of documentary sources such as internal quality assurance data, student assessment results and external examiners' reports. This was partly because of the importance of not placing too heavy a burden on the case study departments (whose good-will was essential) or on the individual lecturers for whom this PhD research represented another intrusion into their already very busy professional lives. Moreover, the student questionnaire, normally administered during a GIS session, proved an efficient and convenient way of obtaining a lot of information on GIS teaching and the student experience, particularly given the mix of structured and open-ended questions. The blend of numerical and qualitative data provided by the survey was helpful as was the volume of data obtained, although this did mean that the analysis had to be a little selective and no doubt this substantial data base could have been used even more extensively.

The staff interviews, classroom observations and module handbooks added fresh perspectives and allowed for triangulation and for assessing the reliability of evidence from different data sources. In the interviews, the staff spoke openly about their work and the problems and pleasures of GIS teaching. With respect to classroom observations, I did not sense that the lecturers were trying to impress or put on a special “show”. In the first couple of UK observations, the pace of the lecturers’ delivery proved a little challenging for my still-improving command of English, but the fact that I had previously observed, or acted as a demonstrator in GIS classes in both Plymouth and Turkey was helpful. Overall, therefore I am satisfied that this thesis presents a substantial and original analysis of GIS pedagogy, and that the information contained is reliable.

The third aim for this thesis was to explore the issues of employability and in particular how well GIS education, as provided by Geography departments, meets commercial market needs. In this area of the thesis, in addition to students’ and staff’s views, important insights were provided through interviews with 14 GIS employers (6 in the UK and 8 in Turkey). Given the many different kinds of GIS employer, the limits imposed by the relatively small sample must, of course, be acknowledged. Nonetheless, some interesting themes emerged (for example, in Turkey the special importance of English language skills in the GIS sector). Moreover, the interview findings were supplemented in both the UK and Turkey by a review of GIS job advertisements – totalling more than 400.

Perhaps, the most important gap in the employment discussion is the views and experience of alumni now working in the GIS field. However, it was judged that there were serious operational difficulties in conducting alumni surveys both in Turkey and the UK and that two more surveys would have seriously overloaded and already large the PhD programme. Fortunately, there is now one published alumni study in the UK (Whyatt et al. 2011) which has helped to plug this gap but no such study exists for Turkey. Despite this alumni consideration, it is considered that this thesis makes a useful contribution to our understanding of GIS employability issues not least with reference to the skills required for different kinds of posts, the extent of Geographers' "penetration" of the GIS labour market and links between academic Geography and GIS employers and professionals.

Taken as a whole, with its focus on GIS provision, pedagogy and employability, this thesis is the first of its kind in both the UK and Turkey. It certainly can claim to make an original contribution to knowledge and to have succeeded in addressing all its specified aims, culminating in a set of recommendations for improved practice. Moreover, although including studies of both the UK and Turkey has added considerably to the workload, it has also added to thesis's value and interest. The fact that very similar research methods were deployed in both countries has also helped to make comparisons and enabled each country's experience to be placed in a rather wider context. In order that the findings and lessons from this research can be made available to a large audience, once the thesis has been completed and appropriate corrections made, the intention is to publish the results in scholarly journals, adding to the two introductory papers already published (Seremet and Chalkley 2012, Seremet et al. 2012).

10.4.2 Personal reflections

As well as the academic aims of this PhD project, a number of personal aims were also identified. This section comments on how far these personal aims were achieved:

a) Research skills: I would personally say that this research project including many different methods and sources, has help me to improve my insights into both quantitative and qualitative-oriented research approaches. I am more confident and competent as a researcher.

b) GIS skills: during my PhD programme, I read widely about GIS and was personally involved in second year GIS modules at Plymouth University in both semesters. I completed more than 100 hours of demonstrating experience in GIS and Statistics modules. This helped to update both my GIS and quantitative skills, as did my PhD research on other departments.

c) Academic English skills: I was involved in several language development activities to improve my English. These included formal classes, writing papers, and making oral presentations. I was particularly pleased to receive a prize for the best oral Geography PhD presentation at a recent Plymouth conference. My English has improved (especially in the last year) and I look forward to writing research publications in English though perhaps with help of one of more English academics.

d) Developing networks; during my PhD research I have been involved in three main research groups in the RGS-IBG and with AGI; twice I was awarded bursaries by the RGS-IBG GIScience and Quantitative Research groups. In addition through my six UK CSDs, I have made contact with other GIS lecturers and gained a number of new colleagues. This was also supported by the GEES Subject Centre activities which I attended. All this is, of course, in addition to contacts with my Plymouth Geography colleagues and others interested in pedagogic research. I plan to continue many of these contacts when back in Turkey.

e) Academic organisation and management: I have been involved in a variety of Plymouth Geography activities (job interviews, meetings etc.) in order to understand how the department is managed and how decisions are made, I have also developed a better understanding of UK HE systems as well as the role and mission of EU-funded training and educational projects such as Erasmus and Marie-Curie. I also, learned, of course, through visiting and studying ten the case study departments.

f) Pedagogic and other HE issues: I attended many different personal development courses and workshops organized by the Plymouth Graduate School as well as pedagogic research and other CPD events. Within Geography I ran the IT induction for the first year students. In this way, I gained some experience of how to work with other colleagues as well as students. All these activities and especially my 100 hours of demonstrating and 30 CPD events will help me to discharge my teaching duties when I return to Turkey as a young academic.

Overall, being an overseas PhD student has been a very worthwhile, though sometimes challenging, learning experience and I would say that I have taken good advantage of the opportunities provided. My written and spoken English has improved considerably and I have developed a good first-hand knowledge of a range of social science and education research methods. I now also have a strong understanding of the priorities and day to day practices of UK Higher Education. Above all the PhD programme presented in this thesis has substantially improved my research skills and my understanding of what is required for high quality student learning experiences in GIS. I plan to put these principles into practice when I return to Turkey to take up the post of GIS lecturer in which I will continue to undertake pedagogic research. In these ways, the principal aims of my scholarship provided by the Higher Education Council of Turkey have been achieved.

APPENDICES

APPENDIX-1: Interview schedule for GIS staff

Introduction

My name is Mehmet Seremet; I'm doing a PhD in the School of Geography, Earth and Environmental Science at the University of Plymouth. My supervisors are Prof Brian Chalkley and Dr. Ralph Fyfe. The aim of this interview is to gather information about the pedagogical aspects of the GIS teaching being delivered by yourself and the development of GIS Education in your department.

First of all, I would like to remind you that 1) you can, of course, end the interview at any time and that 2) you don't have to answer these questions. However, I would greatly value your participation and can assure you of the anonymity of your replies.

The interview will take a maximum of 60 minutes. Are you available to respond to a number of questions at this time? Do you mind if I record our discussion?

First Part: Personal Information and GIS Provision

1. Would you like to give me some brief information about yourself such as your main academic interests, how you became involved in GIS and any professional experience in GIS you may have had outside Higher Education.
2. How did you become interested in GIS teaching? How do you identify yourself within the GIS field (as a GIS user or a GIS specialist)?
3. Do you have any formal teaching qualification as such?
4. How do you keep abreast of new developments in GIS and the teaching of GIS?
5. With respect to the Geography undergraduate degree, Could you please give me brief information about your GIS module(s)? What is the title, which year of the course (s) is it in and is it compulsory or optional? Additionally, is there any introductory GIS teaching for first year Geography students in your department? If there is, can you please give me some brief information about it?
6. (If appropriate) In what ways is the GIS degree provision/the Master level GIS provision different from the undergraduate module (s)?

7. How many students are taking a) GIS module(s) within Geography programmes / b) GIS degree programmes/ c) Master GIS programmes? Over the last 5 years is the number growing, stable or tending to decline?
8. How much and in what ways does GIS feature in other parts of the Geography degree curriculum?

Second Part: Development of GIS Education

1. What do you see as the main role and purpose of GIS teaching in your department?
2. When and why did your department start to offer a GIS module(s)/programme/ or Masters Programs?
3. If you obtained your GIS education in the UK, what kinds of changes have you seen in GIS education?
4. Has your GIS curriculum and teaching changed significantly in the last 5 years? If so, how?

Third Part: Module/Programme design and specifications

1. How did you design your module/programme specifications such as the curriculum, learning outcomes (ILOs), teaching methods and assessment techniques? Did you get any support from teaching and learning units in your university?
2. Are you aware of the NCGIA, the UCGIS/AAG Body of Knowledge or British Syllabus? If so, did you make use of these documents in your design process and were they useful and why/why not?
3. Did you make use of the QAA Geography Benchmark statement?
4. What are the main kinds of teaching methods and materials you are using in your GIS classes?
5. Why are you using particularly these methods? What factors are most important to you when choosing a GIS teaching method or learning activity?
6. What kind of assessment methods are you using in your GIS teaching and why?
7. Do you face any significant problems in delivering your GIS teaching? If so, what are they?

Fourth Part: Employability

1. What do you think about the employability potential of Geographers in the GIS labour market?
2. Do you think your own GIS students' knowledge and skills are good enough to get a GIS job? (Where appropriate, distinguish the level of GIS provision)
3. Do you know roughly what proportion of your students go on to get GIS-related jobs? (Where appropriate, distinguish the level of GIS provision)
4. Apart from GIS knowledge and skills, in what other ways does your module /course enhance your students' skills and prepare them for the world of work? What kind of teaching and learning activities are you using to improve students' transferable skills in the GIS module/course?
5. Do you get regular feedback from your (a) former GIS students or (b) from GIS employers? If so, what do they say?
6. Could you please tell me whether and how you obtain information on the career which your recent graduates have entered?

Fifth Part: Closing Remarks

Well, it has been a pleasure finding out more about you and your GIS teaching.

- Is there anything else you think it would be helpful for me to know?
- Can I contact you again if I need any further information?
- Thank you so much again for your participation in this study.

APPENDIX-2: Survey of GIS Students in Undergraduate Geography Programmes

Dear Participant,

This questionnaire is a part of a PhD research project dealing with GIS Education. The aim of this research is to explore GIS education in Geography Departments/units. It is focused on teaching and learning. The questionnaire is divided into four sections: basic student demographic information, the teaching and learning experience, skills development and motivations. As a student, your contribution to this study is very important. The results of the survey will be used for research purposes only.

Finally, I would like to remind you that you can, of course, withdraw from the study at any time. However, I would greatly value your participation and can assure you of the anonymity of your replies. This data will be kept strictly confidential and destroyed after the study is completed. Thank you for taking part.

Contact details

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SECTION I: Demographic Information

1. Please give your gender:	
1. ( ) Female 2. ( ) Male	
2. Please give your age range:	
1. ( ) 18-25 2. ( ) 26-33 3. ( ) 34+	
3. Please give your current year of study:	
1. ( ) 1st year	4.( ) 4th year
2. ( ) 2nd year	
3. ( ) 3rd year	
4. Please give the title of the course/award for which you are studying (e.g. BSc Geography):	
………………………………………………………..…………………………….	
5. Please give the title of the GIS module (s) in which you are enrolled:	
……………………………………………………..	
6. Please give name of the Department in which you are enrolled:	
……………………………………………………..	
7. Did you receive any introductory GIS teaching in your first year? If so, could you please give the title of the module(s) within which GIS was taught:	
1. ( ) Yes (…………………………………………………………………………………….)	
2. ( ) No	3. ( ) Don't know
8. How many GIS modules (or modules with a substantial GIS component) have you undertaken (including current modules)?	
....….................................	

SECTION II: Teaching and learning experiences

2a. How often have you experienced the following teaching activities within the current GIS module(s)?

When answering each of the questions below, please use the following scale;

"Always": %100 of classes **"Sometimes":** more than 50% of classes **"Seldom":** less than %50 of classes **"Never":** never at any time.

Teaching and learning activities	Frequency of use			
	Always	Sometimes	Seldom	Never
1. GIS project planning tasks				
2. Undertaking GIS project (s)				
3. Structured GIS activities in a computing suite.				
4. Mobile GIS using activities by handling Notebook or PDA.				
5. Data collection activities by using compass or other analog survey methods in the field.				
6. Data collection activities using GPS in the field.				
7. GIS using activities in the field.				
8. Orienteering activities in the field using GPS, GIS or maps.				
9. Primary data collection activities e.g. interviews or questionnaires				
10. Presenting results of GIS activities (either oral or poster presentations)				
11. Secondary data collection activities in field or online.				
12. Work-placement learning activities in real working environment				
Others (please specify):				

SECTION III: Skills development

3a. Please rate your personal competence in the GIS skills you have developed during the GIS module(s)

As a GIS student, I'm able to:	Advanced	Moderately skilled	Kow the basics	No experience
1. use software tools				
2. use geometric measurement techniques				
3. load and explore national datasets				
4. create geo referenced spatial data				
5. create spatial and attribute queries with the help of SQL				
6. create spatial data bases				
7. import spatial data from different sources				

8. select suitable map projections according to aims and geography locations				
9. edit spatial data				
10. classify data				
11. undertake multi-criteria selection analysis on attribute data				
12. create vector based data by using digitizing techniques				
13. create vector data through importing coordinate points				
14. create choropleth maps				
15. create density maps				
16. do buffer zone analysis				
17. do point-in-polygon analysis				
18. do overlay and intersection analysis				
19.do neighbourhoods analysis (e.g. filters, cluster analysis)				
20. create Layouts to produce high quality output mapping				
21. run multi-variety statistical analysis				
22. run hillshade or solar radiation analysis				
23. make network analysis				
24. select and run appropriate interpolation methods				
25. undertake post-processing of GPS				
26. develop conceptual data models				
27. script GIS processing tools (e.g. using Python)				
28. create a web-based GIS application (JavaScript and PHP)				
29. set up a GIS online database				
30. use program language (e.g. using C, C++, Java etc.)				
31. apply relationship classes in object oriented databases				
32. develop complex data processing models through batching tools together				
33. visualise field and object data in 3D				
34. develop and enforce topological rules when creating spatial data				
Others (please specify):				

3b. To what extent has the GIS module (s) enhanced your transferable/generic skills?

	Significant Enhanced	**Minor Enhanced**	**No effect**
1. Research Skills (Qualitative)			
2. Research Skills (Quantitative)			
3. Team Working			
4. Problem Solving			
5. Creativity			
6. Leadership			
7. Critical Thinking			
8. Organization			
9. Empathy and insight			
10. Personal development			
11. Adaptability and Flexibility			
12. Project Management			
Others (please specify):			

SECTION IV: Motivation and wider use of GIS

4a. To what extent have any assessment exercises/course work helped with your of understanding of GIS? Why?

A Great Deal ☐ Much ☐ Somewhat ☐ Little ☐ Not at all ☐

<u>Please explain your answer</u>

………

………

4b. Would you please explain why you chose your current GIS module (if it is an elective module)?

<u>Because</u>………………………………………………………………………………………………

………

………

4c.How often have you made use of GIS in your other modules? In what ways?

Always ☐ Frequently ☐ Sometimes ☐ Rarely ☐ Never ☐

<u>Please briefly illustrate your use of GIS in other modules</u>

………

………

4d. To what extent and in what ways do GIS module (s) differ from the other Geography Modules?

………

………

………

4e.Do you intend to proceed to a career in which your GIS skills will be useful?

☐ Yes ☐ No ☐ I don't know

<u>Please give reasons for your answer</u>

………

………

4f.Was GIS a reason why you chose to do a Geography Degree (or Geography related degree)?

☐ Yes ☐ No ☐ Not Sure

Please explain your answer
………
………

4g. To What extent has the current GIS module (s) met your expectations?

To a Very Great Extent	To a Great Extent	Somewhat	To a Small Extent	To a Very Small Extent
☐	☐	☐	☐	☐

Please explain your answer
………
………

4h. To What extent are you satisfied with your current GIS module (s)?

Highly Satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Highly Dissatisfied
☐	☐	☐	☐	☐

Please explain your answer
………
………

4j. Which aspect (s) of GIS module (s) have you found (a) most and (b) least valuable? Why?

Most valuable:	**Least valuable:**
……………………………………………………………	……………………………………………………………
……………………………………………………………	……………………………………………………………
……………………………………………………………	……………………………………………………………

4i. Any other comments

....
....
....
....

Thank you for taking time to complete this survey.

APPENDIX-3: Survey of Undergraduate GIS Degree Students

Dear Participant,

This questionnaire is a part of a PhD research project dealing with GIS Education. The aim of this research is to explore GIS education in Geography Departments/units. It is focused on teaching and learning. The questionnaire is divided into four sections: basic student demographic information, the teaching and learning experience, skills development and motivations. As a student, your contribution to this study is very important. The results of the survey will be used for research purposes only.

Finally, I would like to remind you that you can, of course, withdraw from the study at any time. However, I would greatly value your participation and can assure you of the anonymity of your replies. This data will be kept strictly confidential and destroyed after the study is completed. Thank you for taking part.

Contact details

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7 Kirkby Place, University of Plymouth

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E-mail address: mehmet.seremet@plymouth.ac.uk, Tel: 07787239290

SECTION I: Demographic Information

1. Please give your gender:		
1. ( ) Female 2. ( ) Male		
2. Please give your current year of study:		
1. ( ) 1st year	4.( ) 4th year	
2. ( ) 2nd year		
3. ( ) 3rd year		
3. Please give your age range:		
1. ( ) 18-25	2. ( ) 26-33	3. ( ) 34+
4. Please give the title of the course/award for which you are studying, (e.g. BSc GIS):		
………………………………………………………….………………………………….		
5. Please give the name of the Department in which you are enrolled:		
…………………………………………………………..……………………………....................		

SECTION II: Teaching and learning experiences

2a. How often have you experienced the following teaching activities within the GIS programme?

When answering each of the questions below, please use the following scale;

"Always": %100 of classes **"Sometimes":** more than 50% of classes **"Seldom":** less than %50 of classes **"Never":** never at any time.

Teaching and learning activities	Frequency of use			
	Always	**Sometimes**	**Seldom**	**Never**
1. GIS project planning tasks				
2. Undertaking GIS project (s)				
3. Structured GIS activities in a computing suite.				
4. Mobile GIS using activities by handling Notebook or PDA.				
5. Data collection activities by using compass or other analog survey methods in the field.				
6. Data collection activities using GPS in the field.				
7. GIS using activities in the field.				
8. Orienteering activities in the field using GPS, GIS or maps.				
9. Primary data collection activities e.g. interviews or questionnaires				
10. Presenting results of GIS activities (either oral or poster presentations)				
11. Secondary data collection activities in field or online.				
12. Work-placement learning activities in real working environment				
Others (please specify):				

SECTION III: Skills development

3a. Please rate your personal competence in the GIS skills you have developed during the GIS module(s)

As a GIS student, I'm able to:	**Advanced**	**Moderately skilled**	**Know the basics**	**No experience**
1. use software tools				
2. use geometric measurement techniques				
3. load and explore national datasets				
4. create geo referenced spatial data				
5. create spatial and attribute queries with the help of SQL				
6. create spatial data bases				
7. import spatial data from different sources				
8. select suitable map projections according to aims and geography locations				

9. edit spatial data				
10. classify data				
11. undertake multi-criteria selection analysis on attribute data				
12. create vector based data by using digitizing techniques				
13. create vector data through importing coordinate points				
14. create choropleth maps				
15. create density maps				
16. do buffer zone analysis				
17. do point-in-polygon analysis				
18. do overlay and intersection analysis				
19. do neighbourhoods analysis (e.g. filters, cluster analysis)				
20. create Layouts to produce high quality output mapping				
21. run multi-variety statistical analysis				
22. run hillshade or solar radiation analysis				
23. make network analysis				
24. select and run appropriate interpolation methods				
25. undertake post-processing of GPS				
26. develop conceptual data models				
27. script GIS processing tools (e.g. using Python)				
28. create a web-based GIS application (JavaScript and PHP)				
29. set up a GIS online database				
30. use program language (e.g. using C, C++, Java etc.)				
31. apply relationship classes in object oriented databases				
32. develop complex data processing models through batching tools together				
33. visualise field and object data in 3D				
34. develop and enforce topological rules when creating spatial data				
Others (please specify):				

3b. To what extent has the GIS programme enhanced your transferable/generic skills?

	Significant Enhanced	**Minor Enhanced**	**No effect**
1. Research Skills (Qualitative)			
2. Research Skills (Quantitative)			
3. Team Working			
4. Problem Solving			
5. Creativity			
6. Leadership			
7. Critical Thinking			
8. Organization			
9. Empathy and insight			
10. Personal development			
11. Adaptability and Flexibility			
12. Project Management			
Others (please specify):			

SECTION IV: Motivation and wider use of GIS

4a. To what extent have any assessment exercises/course work helped with your of understanding of GIS? Why?

A Great Deal	Much	Somewhat	Little	Not at all
☐	☐	☐	☐	☐

Please explain your answer

……………………………………………………………………………………………………...................

....

4b. Would you please explain why you chose your GIS degree programme?

Because…………………………………………………………………………………………

………………………………………………………………………………………………………

……

4c.Do you intend to proceed to a career in which your GIS skills will be useful?

☐ Yes ☐ No ☐ I don't know

Please give reasons for your answer

…………………………………………………………………………………………………….

…………………………………………………………………………………………………....

4d. To what extent has the GIS degree programme met your expectations?

To a Very Great Extent	To a Great Extent	Somewhat	To a Small Extent	To a Very Small Extent
☐	☐	☐	☐	☐

Please explain your answer

……………………………………………………………………………………………………...................

....

4e. To What extent are you satisfied with your GIS programme?

Highly Satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Highly Dissatisfied
☐	☐	☐	☐	☐

Please explain your answer

………

………

4f. Which aspect (s) of your GIS programme have you found (a) most and (b) least valuable? Why?

Most valuable:	**Least valuable:**
……………………………………………………………	……………………………………………………………
……………………………………………………………	……………………………………………………………
……………………………………………………………	……………………………………………………………

4g. Any other comments

………

………

………

………

Thank you for taking time to complete this survey.

APPENDIX-4: Survey of GIS Masters Students

Dear Participant,

This questionnaire is a part of a PhD research project dealing with GIS Education. The aim of this research is to explore GIS education in Geography Departments/units. It is focused on teaching and learning. The questionnaire is divided into four sections: basic student demographic information, the teaching and learning experience, skills development and motivations. As a student, your contribution to this study is very important. The results of the survey will be used for research purposes only.

Finally, I would like to remind you that you can, of course, withdraw from the study at any time. However, I would greatly value your participation and can assure you of the anonymity of your replies. This data will be kept strictly confidential and destroyed after the study is completed. Thank you for taking part.

Contact details

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E-mail address: mehmet.seremet@plymouth.ac.uk, Tel: 07787239290

SECTION I: Demographic Information

1. Please give your gender:
1. ( ) Female 2. ( ) Male
2. Please give your age range:
1. ( ) 18-25 2. ( ) 26-33 3. ( ) 34+
3. Are you study full-time or part time?
1. ( ) Full-time 2. ( ) Part-time
4. Please give the title of the course for which you are studying, (e.g. Msc GIS):
……………………………………………………………………………………………….
5. Please give name of the Department in which you are enrolled:
....

SECTION II: Teaching and learning experiences

2a. How often have you experienced the following teaching activities within your GIS programme?

When answering each of the questions below, please use the following scale;

"Always": %100 of classes **"Sometimes":** more than 50% of classes **"Seldom":** less than %50 of classes **"Never":** never at any time.

Teaching and learning activities	**Frequency of use**			
	Always	**Sometimes**	**Seldom**	**Never**
1. GIS project planning tasks				
2. Undertaking GIS project (s)				
3. Structured GIS activities in a computing suite.				
4. Mobile GIS using activities by handling Notebook or PDA.				
5. Data collection activities by using compass or other analog survey methods in the field.				
6. Data collection activities using GPS in the field.				
7. GIS using activities in the field.				
8. Orienteering activities in the field using GPS, GIS or maps.				
9. Primary data collection activities e.g. interviews or questionnaires				
10. Presenting results of GIS activities (either oral or poster presentations)				
11. Secondary data collection activities in field or online.				
12. Work-placement learning activities in real working environment				
Others (please specify):				

SECTION III: Skills development

3a. Please rate your personal competence in the GIS skills you have developed during the GIS module(s)

As a GIS student, I'm able to:	**Advanced**	**Moderately skilled**	**Know the basics**	**No experience**
1. use software tools				
2. use geometric measurement techniques				
3. load and explore national datasets				
4. create geo referenced spatial data				
5. create spatial and attribute queries with the help of SQL				
6. create spatial data bases				
7. import spatial data from different sources				

8. select suitable map projections according to aims and geography locations				
9. edit spatial data				
10. classify data				
11. undertake multi-criteria selection analysis on attribute data				
12. create vector based data by using digitizing techniques				
13. create vector data through importing coordinate points				
14. create choropleth maps				
15. create density maps				
16. do buffer zone analysis				
17. do point-in-polygon analysis				
18. do overlay and intersection analysis				
19. do neighbourhoods analysis (e.g. filters, cluster analysis)				
20. create Layouts to produce high quality output mapping				
21. run multi-variety statistical analysis				
22. run hillshade or solar radiation analysis				
23. make network analysis				
24. select and run appropriate interpolation methods				
25. undertake post-processing of GPS				
26. develop conceptual data models				
27. script GIS processing tools (e.g. using Python)				
28. create a web-based GIS application (JavaScript and PHP)				
29. set up a GIS online database				
30. use program language (e.g. using C, C++, Java etc.)				
31. apply relationship classes in object oriented databases				
32. develop complex data processing models through batching tools together				
33. visualise field and object data in 3D				
34. develop and enforce topological rules when creating spatial data				
Others (please specify):				

3b. To what extent has the GIS programme enhanced your transferable/generic skills?

	Significant Enhanced	**Minor Enhanced**	**No effect**
1. Research Skills (Qualitative)			
2. Research Skills (Quantitative)			
3. Team Working			
4. Problem Solving			
5. Creativity			
6. Leadership			
7. Critical Thinking			
8. Organization			
9. Empathy and insight			
10. Personal development			
11. Adaptability and Flexibility			
12. Project Management			
Others (please specify):			

SECTION IV: Motivation and wider use of GIS

4a. To what extent have any assessment exercises/course work helped with your of understanding of GIS? Why?

A Great Deal	Much	Somewhat	Little	Not at all
☐	☐	☐	☐	☐

Please explain your answer

……..................

……

4b. Would you please explain why you chose your GIS Masters degree programme?

Because………………………………………………………………………………………

……

……

……

……

4c.Do you intend to proceed to a career in which your GIS skills will be useful?

☐ Yes ☐ No ☐ I don't know

Please give reasons for your answer

……………………………………………………………………………………………………….

……………………………………………………………………………………………………....

…………………………………………………………………………………………….............

4d. To what extent has the Masters GIS programme met your expectations?

To a Very Great Extent	To a Great Extent	Somewhat	To a Small Extent	To a Very Small Extent
☐	☐	☐	☐	☐

Please explain your answer

…………………………………………………………………………………………………..................

……

4e. To what extent are you satisfied with your GIS programme?

Highly Satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Highly Dissatisfied
☐	☐	☐	☐	☐

<u>Please explain your answer</u>
....
....

4f. Which aspect (s) of GIS programme have you found (a) most and (b) least valuable? Why?

<u>Most valuable:</u>	**<u>Least valuable:</u>**
....	....
....	....
....	....

4g. Any other comments

....
....
....
....

Thank you for taking time to complete this survey.

APPENDIX-5: Survey of GIS Companies/Organizations

My name is Mehmet Seremet. I'm doing a PhD in the School of Geography, Earth and Environmental Science at the University of Plymouth. The aim of this survey is to gather information about the GIS labour market and to explore its relationship with GIS Education.

I would like to remind you that you don't have to answer these questions. However, I would greatly value your participation and can assure you of the anonymity of your replies.

SECTION I: FOCUS ON THIS COMPANY/ORGANISATION

1. Roughly how many people does this company/organization employ here in the UK? Roughly how many of these are GIS specialists?
a)Total employees……………………………………………………………………....   **b)GIS specialists**………………………………………………………………………………
2. What experience do you have in employing graduates in a)Geography b)GIS
a)Geography………………………………………………………………………………………   ………………………………………………………………………………………………………   **b)GIS (undergraduate/postgraduate/other qualifications)**………………………..................
3. Roughly how many of your GIS staff are on short term/project contracts?
……………………………………………………………………………………………………   ………………………………………………………………………………………………………
4. Does your company/organization have links with any Higher Education institutions who provide Geography or GIS courses? Please could you tell me about these links?
....
5. Does your company/organization offer any work placements for students interested in GIS careers? If yes,   a) How many students do you normally take on placement each year?   b) Roughly what proportion of these do you later employ?
a)Placement numbers………………………………………………………………................   **b)Subsequently Employed**………………………………………………………………………
6. What kinds of educational qualifications are most suitable for GIS posts in your company/organization? Why?
………………………………………………………………………………………………………   ....
7. What kinds of specialist GIS expertise are generally most important for recent graduates looking for a post with you in GIS?
....

8. What kinds of transferable skills do you consider most important for your GIS posts?
………..……… ……………………………………………………………………………………………..……………… ………………………………………………………………………………………
9. During the last five years, has the number of GIS posts which your company/organization offers which are suitable for recent graduates increased, decreased or stayed about the same? Why?
The number of jobs: ☐ Substantial increase ☐ Moderate increase ☐ table ☐ oderate decrease ☐ ubstantial decrease **Please explain**……………………………………………………………..........................

SECTION II: THE WIDER UK JOBS MARKET IN GIS

10. What have been the main trends in the **national** GIS job market in terms of the number of jobs and the skills/attributes required over the last 5 years?

The number of jobs: ☐ Substantial growth ☐ loderate growth ☐ table ☐ oderate decline ☐ bstantial decline e ☐ ı't know
Skills:………………………………………………………………………………………………
Attributes:...
………………………………………………………………………………………………
☐ **Don't know**

11. What do you expect to be the main trends in the national GIS job market in terms of the number of jobs and the skills/attributes required over the next 5 years?

The number of jobs: ☐ Substantial growth ☐ loderate growth ☐ table ☐ oderate decline ☐ ıbstantial decline ☐ n't know
Skills:………………………………………………………………………………………………
Attributes:...
………………………………………………………………………………………………
☐ **Don't know**

12. Roughly what proportion of GIS jobs suitable for recent graduates are for short term/contract posts?

………………………………………………………………………………………………………
………..……………………………………………………………………………………………

13. Overall, how satisfied do you think GIS employers are generally with recent graduates from UK Higher Education and why?

Highly Satisfied	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Highly Dissatisfied
☐	☐	☐	☐	☐

Please explain your answer

……………………………………………………………………………………………………

……………………………………………………………………………………………………

14. Would you estimate roughly what proportion of advertised GIS posts you think are these days filled by applicants with (at least) an undergraduate degree in Geography?

……………………………………………………………………………………………………

……………………………………………………………………………………………………

15. Overall, Is there anything else you would like to add about Geography or GIS degree courses and the extent to which they prepare students for GIS employment?

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Thank you for taking time to complete this survey. Please return by e-mail to mehmet.seremet@plymouth.ac.uk

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